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5400 SERIES

DIGITAL VOLTMETER

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Dana Laboratories Incorporated
Irvine, California 92664

Telephone (714) 833-1234
Teletype 910-595-1136

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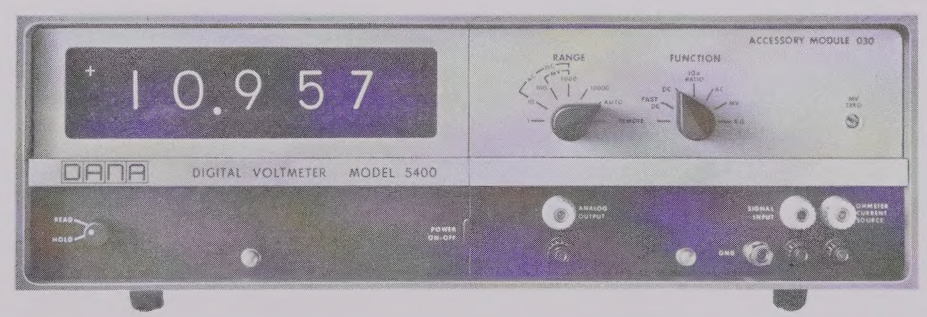
(a) Model 5400 Digitizing & Display Module



(b) Model 5400 with 030 Accessory Module

Figure 1.1. Model 5400 Digital Voltmeter

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Section 1

General Description

1.1 INTRODUCTION

1.2. This manual describes the digitizing and display module of the Dana Model 5400 and Model 5403 Digital Voltmeter. This module, located in the left-hand side of the instrument (Figure 1.1), operates in conjunction with one of the Dana accessory modules. The accessory module is a signal conditioning unit that provides a ten-volt full-scale (plus overrange) analog voltage to the digitizing and display module. The accessory module is located on the right-hand side of the instrument and is described in a separate manual.

1.3. Models 5400 and 5403 differ only in the type of Electrical Output/ Remote Programming accessory available as options. Model 5400 operates with a non-isolated accessory and is suitable for applications in which the program source and the digital output device are isolated from ground. Model 5403 operates with an accessory equipped with isolating relays allowing its use with grounded program sources and output devices. A special power supply is required by Model 5403 to drive the isolating relays. Otherwise, the two models are similar. References in this manual to "Model 5400" refer to both Model 5400 and Model 5403, unless otherwise indicated.

1.4. The Digital Voltmeter output is presented on a four-digit visual display. Accuracy is preserved at the range cross-over points by a fifth overrange digit that extends each range by 10% (9999 to 10999). The output/programming options are described in the separate "Electrical Output and Programming Options" manual.

1.5. All circuits, other than the power supply, are mounted on plug-in circuit boards. The power supply is common to the accessory and digitizing modules and is located at the right rear of the instrument (Figure 1.2). Next to the power supply, at the left rear of the instrument, is the optional Electrical Output and Programming Unit. The location of the circuit boards is shown in Table 1.1. A block diagram showing their electrical arrangement is shown in Figure 1.3.

1.6 OPERATIONAL DESCRIPTION

1.7. The Dana Model 5400 Digital Voltmeter uses the null balance technique to measure the amplitude of unknown voltages. The accessory module converts the input signal to a 10-volt full-scale analog voltage. For example, if the controls are set to measure AC volts on the 100-volt range, a 50-volt rms input signal results in an internal analog voltage of 5 volts DC. This voltage is applied to the Digitizing and Display module where it is "digitized" by comparison with a series of trial-ane-error voltages, each of which is a known digital fraction of a reference voltage. Precision resis-

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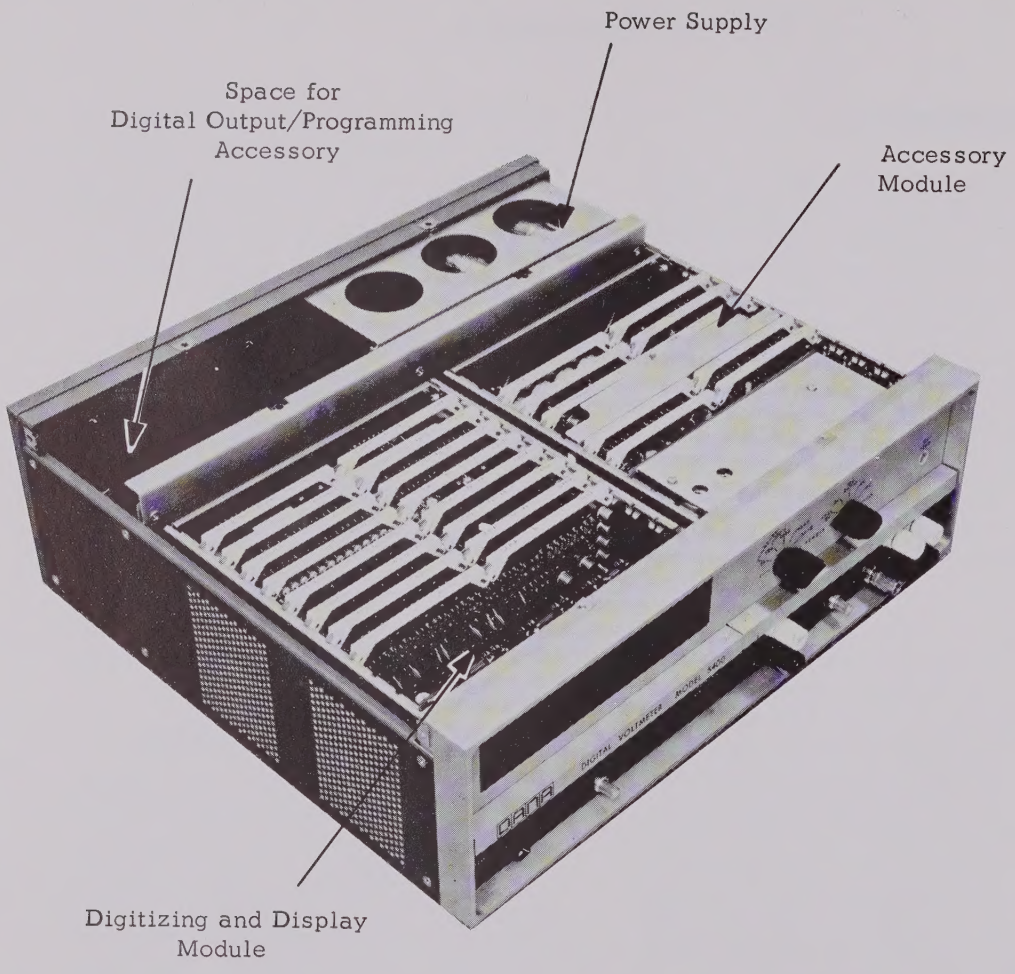


Figure 1.2. Component Location

Table 1.1
Circuit Board Locations

ELECTRICAL OUTPUT AND PROGRAMMING	POWER SUPPLY
J11 - Reference Buffer J10 - Control Logic J 9 - Sequence Logic J 8 - Null Detector J 7 - 1 Decade J 6 - 10 Decade J 5 - 100 Decade J 4 - 1000 Decade J 1 - Display	Accessory Module

Control Panel

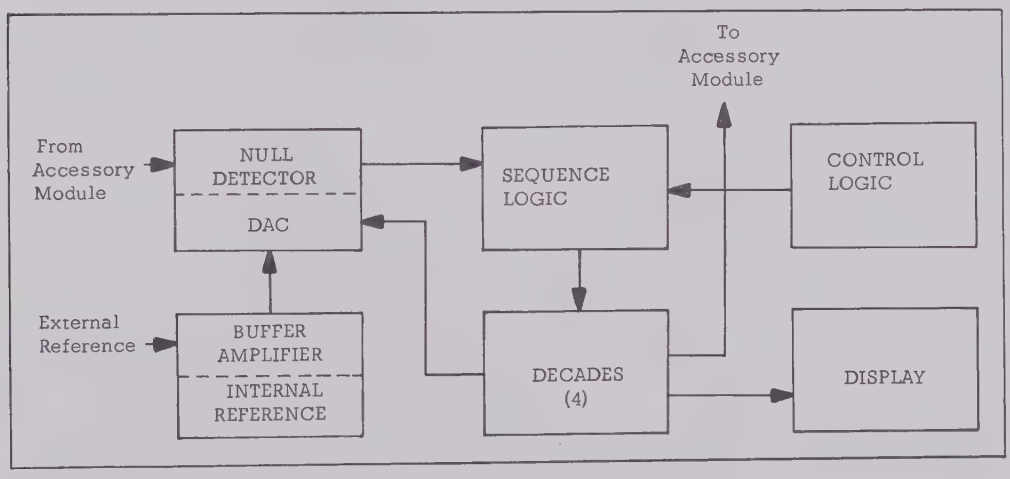


Figure 1.3. Digitizing and Display Module — Block Diagram

tors in the reference-current divider or digital-to-analog converter (DAC) are capable of dividing the reference into 10,000 equally-spaced current increments and to arrive at the closest increment in a maximum of 36 trials. The total digitizing time is less than 2 milliseconds.

1.8. When a null balance has been achieved, the digital setting of the DAC is displayed on the DVM visual readout. The number shown is, in effect, the ratio between the input signal and the reference voltage in parts per 10,000.

1.9. When absolute measurements are being made, a highly stable, Zener-controlled, 10-volt internal reference is used. Since full scale analog voltage from the Signal Conditioning module is also 10 volts (converted to a precision current), the displayed value is read directly in DC volts, millivolts, AC volts or kilohms, with proper placement of the decimal point to adjust for any ranging that has been performed.

1.10. In the above example, the 50-volt rms AC input signal would produce a 5-volt internal analog voltage, which would be balanced by the 10-volt internal reference when the DAC arrives at a value of 5,000 (parts per 10,000). The digital display would carry the numerals 5-0-0-0, and range information from the Signal Conditioning module would place the decimal point to read 50.00. An indicator symbol on the display would show that AC volts were being measured.

1.11. In the ratio measuring mode, the internal 10-volt reference is replaced by an external DC voltage, which may vary from +1 to +11 volts. The displayed value is the ratio between a DC input signal and the reference voltage at that instant. The ratio between +DC voltages and the reference as minus (-) ratios (the external reference voltage must always be positive). This bipolar ratio capability is of particular value in applications, such as bridge balancing, where inputs are likely to pass through zero. Since the signal and reference voltages are being detected simultaneously, the accuracy of the ratio measurement is independent of the stability of the voltage source.

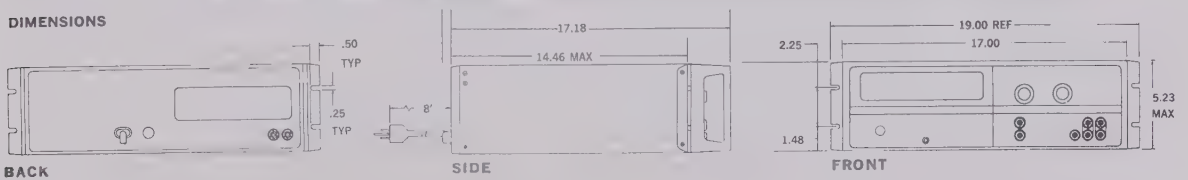
1.12 SPECIFICATIONS

1.13. Specifications of the Model 5400/5403 are listed in Table 1.2.

Table 1.2. Specifications

DC VOLTAGE MEASUREMENTS	**ABSOLUTE (0 to ± 1000 v)**	**RATIOS (+1 to +11 v ref std, +10 to +110 available)**
Full scale ranges, ranging and polarity automatic	±10.999, ±109.99, ±1099.9 v (max input 1000 v)	±1.0999:1, ±10.999:1, ±109.99:1
Accuracy (90 days)	±0.01% of reading ±0.01% of f.s.	±0.01% of reading ±0.01 (10v/E ref)% of f.s.
Temperature coefficient	±0.001% of f.s. per °C	same as absolute
Response time: Digitizing with polarity change	2 milliseconds	same as absolute
Range change (READ mode)	250 milliseconds per range	same as absolute
Full scale step function settling time (to 0.01%)	500 milliseconds with up to 100k-ohm source	same as absolute
Common mode rejection: DC	error <0.01% f.s. per 100 v common mode, with up to 100 ohms in either lead	same as absolute
AC, 61 Hz and below	error <0.01% f.s. per 10 v common mode, with up to 100 ohms in either lead	same as absolute
Normal mode noise rejection	60 dB min, 59 Hz and up; increasing 18 dB/octave; three-pole Gaussian (55 dB min, 49 Hz and up)	same as absolute
Input resistance — at or off null: 10 v range	1000 megohms	signal, 1000 megohms; ref, 20 megohms
other ranges	10 megohms	signal, 10 megohms; ref, 20 megohms
DV VOLTAGE MEASUREMENTS, FAST		
Full scale ranges, ranging and polarity automatic	±10.999, ±109.99, ±1099.9 volts (max input 1000 volts)	
Accuracy (90 days)	±0.01% of reading ±0.01% of f.s.	
Temperature coefficient	±0.001% of f.s. per °C	
Response time: Digitizing with polarity change	2 milliseconds	
Range change (READ mode)	250 milliseconds per range	
Full scale step function settling time (to 0.01%)	15 milliseconds with up to 100k-ohm source	
Common mode rejection: DC	error <0.01% f.s. per 100 v common mode, with up to 100 ohms in either lead	
AC, 61 Hz and below	error <0.01% f.s. per 3 v common mode, with up to 100 ohms in either lead	
Input resistance — at or off null: 10 v range	1000 megohms	
other ranges	10 megohms	
MILLIVOLT MEASUREMENTS (MODULE 031 ONLY)		
Full scale ranges, ranging and polarity automatic	±109.999, ±1099.9 millivolts	
Accuracy (90 days)	±0.01% of reading ±0.02% of f.s.	
Response time: Digitizing with polarity change	2 milliseconds	
Range change (READ mode)	250 milliseconds/per range	
Full scale step function settling time (to 0.01%)	1 second	
Common mode rejection: DC	error <0.01% f.s. per 10 v common mode, with up to 100 ohms in either lead	
AC, 61 Hz and below	error <0.01% f.s. per 10 v common mode, with up to 100 ohms in either lead	
Normal mode noise rejection	40 dB min, 59 Hz and up; increasing 12 dB/octave (36 dB min, 49 Hz and up)	
Input resistance	100 megohms	
ACCESSORIES (MODULE 031 ONLY)	**MODEL 29 AC CONVERTER**	**MODEL 07 OHMS CONVERTER**
Maximum voltage rating	500 v rms, 50 Hz to 10 kHz, decreasing to 150 v at 50 kHz and up	not applicable
Maximum voltage across unknown	not applicable	10 v at f.s., max current 10 ma on 1 k range
Full scale ranges, ranging automatic	1.0999, 10.999, 109.99, 1099.9 v rms	1.0999, 10.999, 109.99, 1099.9, 10999 kilohms
Accuracy (90 days):10, 100, 1000 ranges	50 Hz to 10 kHz: ±0.08% rdg ±0.02% f.s.	1,10 and 100 ranges: ±0.01% of reading ±0.01% f.s.
	10 kHz to 50 kHz: ±0.2% rdg ±0.05% f.s.	1000 range: ±0.03% of reading ±0.01% f.s.
	50 kHz to 100 kHz: ±0.9 rdg ±0.1% f.s.	10,000 range: ±0.07% of reading ±0.05% f.s.
1 range	50 Hz to 10 kHz: ±0.18% rdg ±0.02% f.s.	
Response time: Digitizing	2 milliseconds	2 milliseconds
Range change (READ mode)	250 milliseconds per range	250 milliseconds per range
Full scale step function settling time	0.3 second (to 0.1%)	1, 10, 100 kilohm ranges: 2 sec; 1 meg range: 3 sec; 10 meg range: 2 sec plus 1 sec/meg (to 0.01%)
Common mode rejection: DC	not applicable	error <0.01% f.s. per 100 v common mode, with up to 100 ohms in either lead
AC, 61 Hz and below	error <0.01% f.s. per 10 v common mode, with up to 100 ohms in either lead	error <0.01% f.s. per 10 v common mode, with up to 100 ohms in either lead
Input resistance (all ranges)	1 megohm in series with 0.22 microfarad	not applicable
Shunt capacitance at terminals	front input: less than 140 pF; Parallel rear input: less than 200 pf.	not applicable
GENERAL SPECIFICATIONS AND ORDERING INFORMATION		
Measurement rate in READ mode	4 readings/second	
Maximum common mode voltage	250 volts	
Maximum power requirement	40 watts, 105 to 125 v (export 210 to 250 v), 50 to 400 Hz	
Warm up	1/2 hour to full accuracy	
Operating temperature range	0° to 50°C. accuracy and tempco specs apply from +12° to +50°C.	
Weight	25 pounds (approx) net, 30 pounds (approx) shipping	
Analog electrical output	10 v f.s. at 1 milliamp. Accuracy: dc and ohms, ±1 mv; ac same as Model 29. Output resistance: 5 Ω	

DIMENSIONS



BACK SIDE FRONT

Section 2

Installation

2.1 UNPACKING AND INSPECTION

2.2. The Model 5400 Digital Voltmeter is crated in a plastic foam container consisting of two half-forms joined together and securely taped. The forms are contoured so as to hold the digital voltmeter firmly in place with the container absorbing any reasonable external shock. Before uncrating, examine the container for any sign of external damage.

2.3. Carefully cut the tape holding the two half-forms together and remove the digital voltmeter. Inspect the digital voltmeter for signs of damage. If damage is found, notify the carrier immediately.

2.4. Remove the two modules from the DVM enclosure by turning the knurled knobs counterclockwise and pulling on the aluminum channel across the front panel of each module. Be sure that all circuit boards are firmly seated in their connectors. Normally, there is no need to remove each board; however, a visual check for obvious damage should be made.

2.5. Reseat the modules by pressing them firmly into the connectors at the rear of each drawer assembly. Lock in place by turning the knurled knobs fully clockwise.

2.6. The Model 5400, as shipped, is designed for bench-top operation. A standup bracket is provided under the case to aid in reading the visual display. To adapt the Model 5400 for rack mounting, flanges are attached by removing the two screws holding the side panels to the front bezel casting and replacing them with the longer screws provided with the rack-mounting flanges. The flanges are supplied in pairs, with Part No. F-450820 applying to a pair of flanges alone. For integral flanges and carrying handles, specify Part No. FH-450820. For carrying handles only, specify Part No. H-450820.

2.7 POWER CONNECTIONS

2.8. A standard eight-foot, three-wire, power cable is supplied with the instrument. This cord connects to a three-pin power connector at the rear of the unit.

2.9 INPUT/OUTPUT CONNECTIONS

2.10 Inputs/Analog Output

2.11. Signal input and analog output binding posts are located on the front of the accessory module (accessory 005 has no analog output). Binding posts for the reference input, used for ratio measurements, are located on the rear of the instrument (except on 005). Connection to these terminals are made with standard "banana" plugs. Models equipped with a rear input connector (designated as Model 5400-1) use a

six-pin cable connector wired in parallel with the front-panel binding posts. The mating connector is supplied with the instrument. Refer to the instruction manual covering the accessory module for pin assignments of the rear input connector and for instructions on use of the analog output.

2.12 REMOTE PROGRAMMING/ ELECTRICAL OUTPUT

2.13. The Remote Programming/Electrical Output accessory fits into the rear panel of the digital voltmeter enclosure. It carries two 50-pin connectors. The connector on the right-hand side (as viewed from the rear) is the Digital Output connector, J202. The left-hand connector is the Remote Programming Input connector, J204. Printers and other digital recording devices may be driven by the voltage-levels present on the pins of the Digital Output connector. Pin assignments of the two connectors are given in the "Pin Assignments and Coding" chart for the particular option. The charts are included in the "Model 5400 Electrical Output and Programming Options" manual along with instructions for wiring each option and directions for programming.

NOTE: Refer also to the Installation instructions (Section 2) of the accessory module instruction manual.

Connector	Dana P/N	Mfr.	P/N
Digital Output J202	600015	Amphenol	57-40500
Mating Connector	600047	Amphenol	57-30500
Rear Input J203	600259	Amphenol	97-3102A-14S-6S-639
Mating Connector	600260	Amphenol	97-3106A-14S-6P-639
Hood	601639	Amphenol	97-3057-6A-639
Remote Programming J204	600015	Amphenol	57-40500
Mating Connector	600047	Amphenol	57-30500

Table 2.1. Mating Connector Identification

Section 3

Operation

Since operation of the instrument depends on the accessory module used, refer to "Operation" of the appropriate accessory manual.

Section 4

Theory Of Operation

4.1 SCOPE

4.2. This section covers theory of the Model 5400 Digitizing and Display Module. Refer to the Accessory Module instruction manual for theory of operation of that unit.

4.3. The last figure in this section, figure 4. , is a functional intraconnection diagram of the Digitizing and Display module. The figure can be unfolded allowing the diagram to be referenced while reading the circuit descriptions throughout this section.

4.4. The descriptions and simplified diagrams in this section are intended to supplement the complete schematics included in Section 6. Logic symbols used in the diagrams are defined in Figure 4.1.

4.5 GENERAL DESCRIPTION

4.6. A simplified drawing of the Model 5400 Digitizing and Display module is shown in Figure 4.2. Inputs from the Accessory module are applied to a summing junction at the input to the Null Detector. Regardless of the polarity of the voltage being measured, the sum of the currents from the accessory module is always -2mA full scale.

4.7. DAC current supplied to the summing junction is the analog equivalent of the digital value represented by the state of the Decade flip-flops. When the summing junction is brought to null, the state of the flip-flops indicates exact digital value of the input signal.

4.8. The digitizing process, or "conversion", begins when the Start/Stop

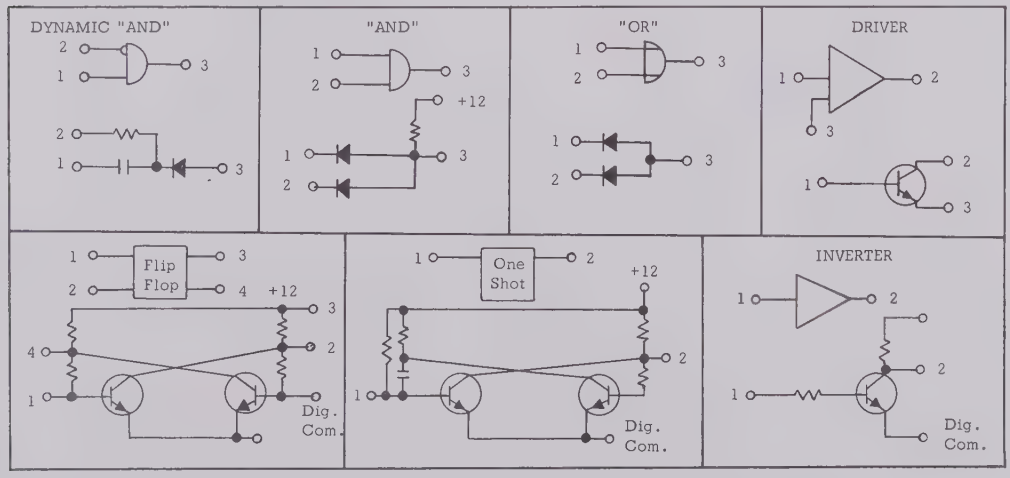


Figure 4.1. Dana Logic Symbols

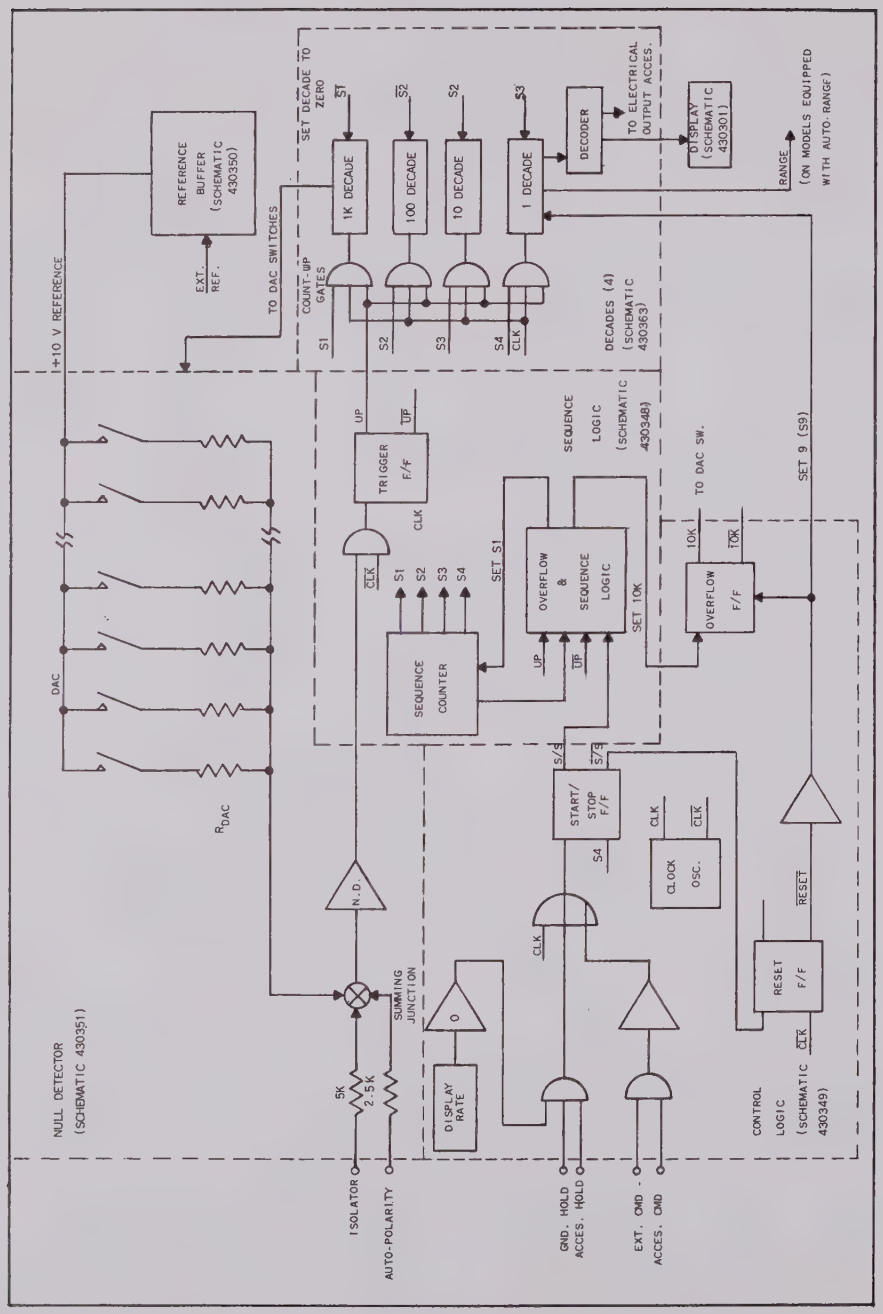


Figure 4.2 - Block Diagram - Digitizing Module

flip-flop (on the Control Logic board) is set. Start/Stop is set by either of two conditions. The Display Rate circuit turns it on automatically every 250 milliseconds unless inhibited by a ground level at the Ground Hold input (READ/HOLD switch on HOLD) or a ground level at the Accessory Hold input. Start/Stop is also set by an external Command received through the remote programming input — or by an accessory command if the instrument is so equipped.

4.9. As Start/Stop is set, the negative-going edge of START/STOP sets the Reset flip-flop. RESET is inverted to become S9 (Set 9) and applied to each of the Decades. Each Decade has four flip-flops, representing 2*-4-2-1 for that Decade. S9 sets the Decades to 9999. If, with the four Decades set to nines, DAC current is less than the input, the Overflow flip-flop is turned on by Overflow detecting logic on the Sequence Logic board. This adds additional DAC current representing a fifth digit (10K). If the resulting DAC current is still too low, the digitizing cycle is completed and the unit is made to up-range. If no higher range is available or permitted, the over-range condition (10999) may be printed to indicate an excessive input.

4.10. Normally, however, the initial setting of 9999 results in a DAC current greater than the input current. This condition is detected by logic on the Sequence Logic board; the Sequence Counter is stepped to sequence state 1 (S1).

4.11. In S1, the 1K Decade is "dropped" (each flip-flop "off"). The Decades are now set to 0999. If the resulting DAC current is less than the input current, the Null Detector causes the generation of UP at the Trigger flip-flop. The 1K Decade now counts up on each clock pulse until DAC current becomes equal to or greater than the input current. This condition is indicated by UP going "false". The Sequencer then advances to S2 and the 100 Decade is "dropped". If DAC current is less than the input current, the 100 Decade is counted up in the same manner as the 1K Decade. This is repeated for each succeeding Decade. At the end of S4, during which the 1 Decade is counted up, the Start/Stop flip-flop is turned off. At this time, the state of the Decades represents the digital value of the input signal and the conversion is complete. This operation is illustrated in the timing diagram of Figure 4.3. In the illustration the input is 03456. Figure 4.4 shows the timing with an input of 10756 (overrange).

4.12 CIRCUIT DESCRIPTIONS

4.13 NULL DETECTOR (Schematic 430351)

4.14. There are two main elements on the Null Detector circuit board. The precision DAC (digital/analog converter) resistor matrix is controlled by the state of the Decade flip-flops. The Null Detector itself is an amplifier that detects and amplifies any difference in input current and DAC current.

4.15. A summing junction at the input to the Null Detector receives inputs from the Accessory Module. (Typically, the inputs from the Accessory Module are from the Isolator and Auto Polarity circuits although on certain accessory modules, special circuits are used. Refer to the Accessory

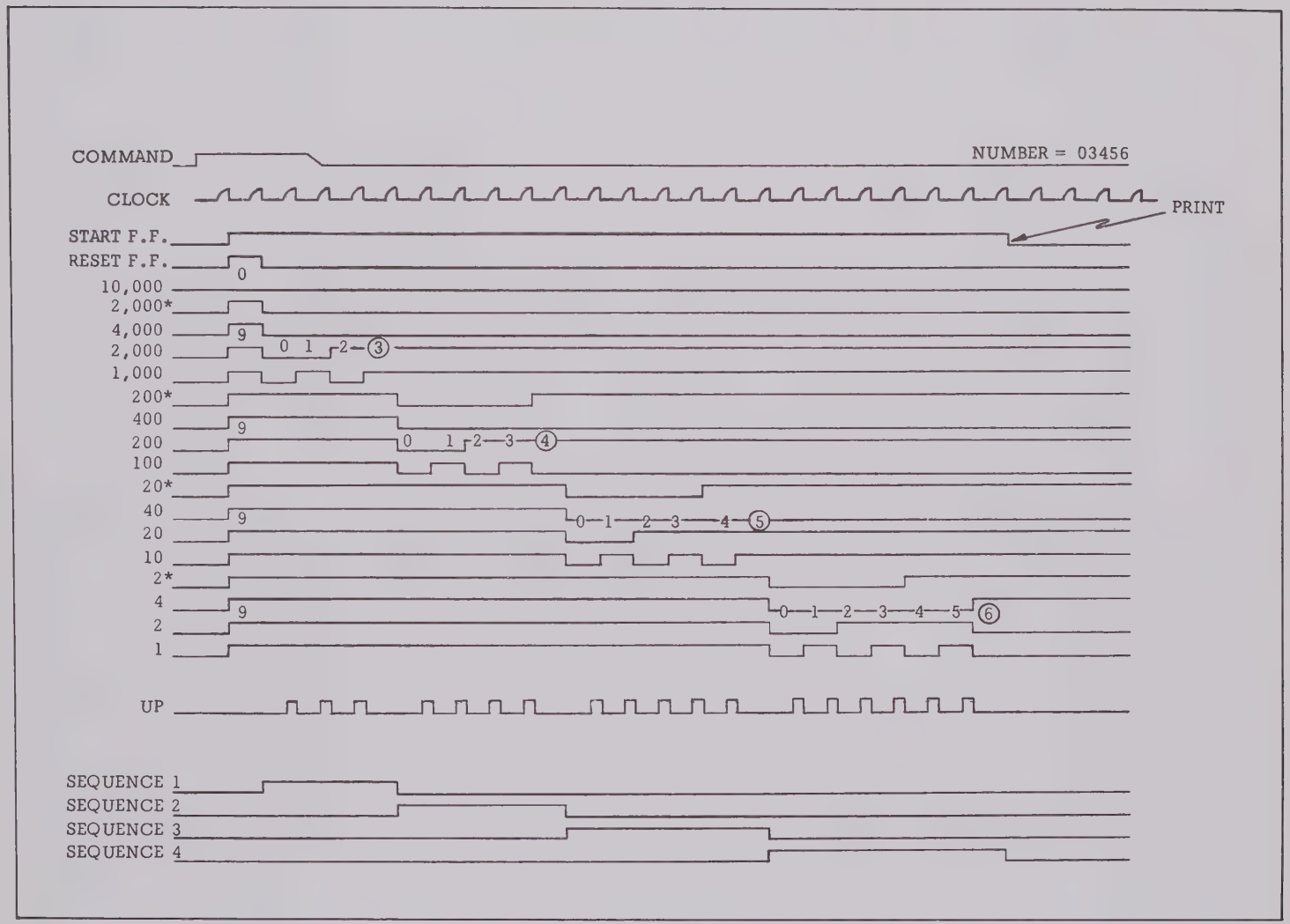


Figure 4.3 - Timing Diagram (Without Overrange)

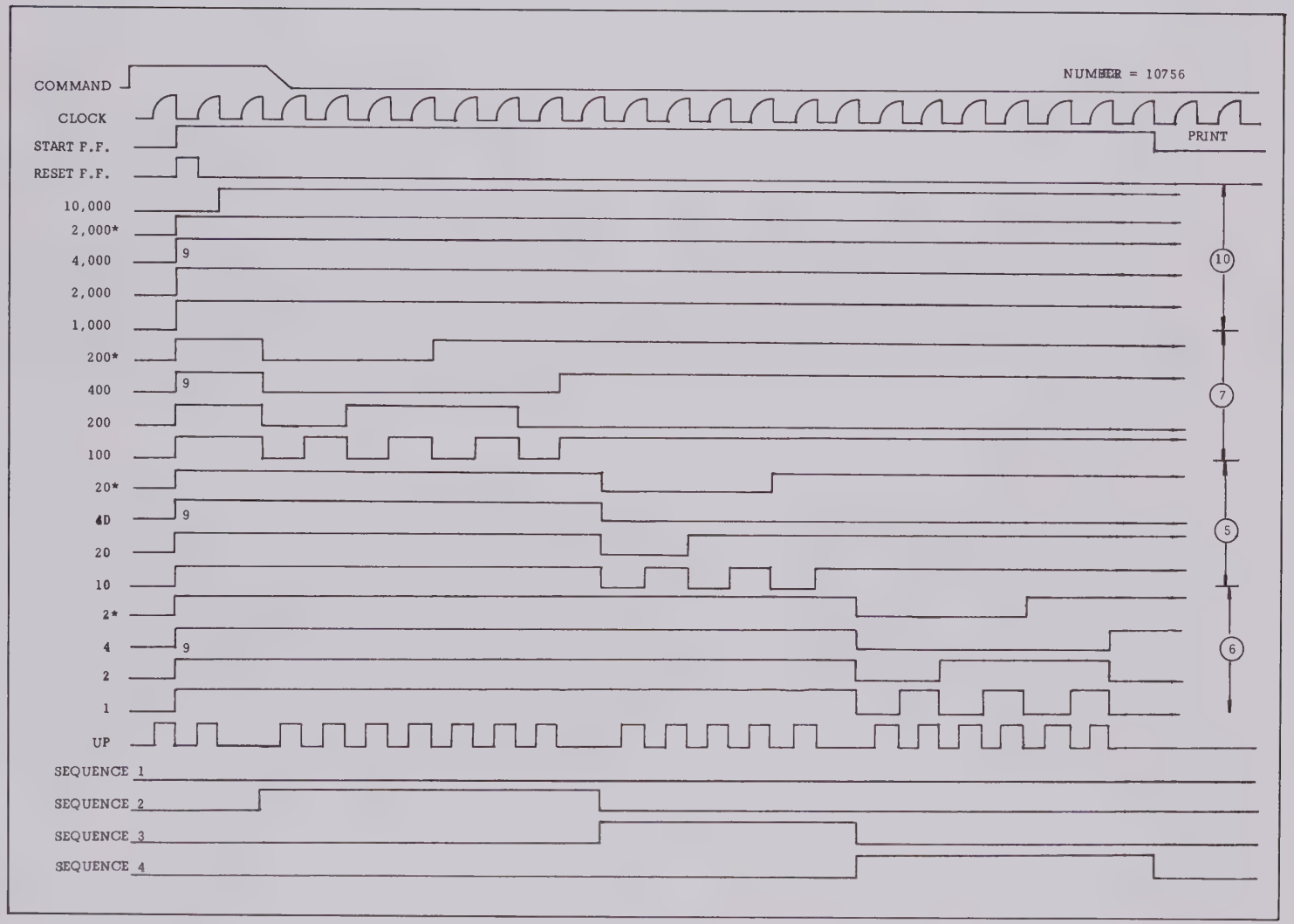


Figure 4.4. Timing Diagram (With Overrange)

Module instruction manual.) The input voltages are such that the sum of the current through the two input resistors is always negative. This can be seen by considering full-scale inputs to the instrument of both polarities (scaled 10 volts). With a negative input voltage, the Auto Polarity voltage is zero. Therefore, the current through the 2.5K resistor is -2mA (-10/5K). With a positive input voltage, the Auto Polarity output is 10 volts applied back through the negative feedback leg of the Auto Polarity amplifier. This results in current through the 2.5K resistor of -4mA. At the same time the Isolator output is +10 volts resulting in +2mA through the 5K resistor (10/5K). The sum of the two currents (-4mA and +2mA) is -2mA.

4.16. The negative current is balanced out by a positive current from the DAC resistor network. The current is developed from a precise 10-volt reference voltage from the Reference Buffer circuit board for absolute measurements or from an external reference when ratios are being measured. In the initial condition where all four Decades are set to 9, the resistors are all switched into the DAC circuit. Since the resistors are in parallel, the resulting DAC current is maximum.

4.17. A typical DAC switch is shown in Figure 4.5. Q2 is normally on and R_{DAC} is in the circuit. When a positive voltage is applied to the base of Q1, Q1 is turned on and the resulting ground level at the base of Q2 back biases Q2 and R_{DAC} is out of the circuit. As shown in the figure, the switch is operated by the "not" side of the Decade flip-flop. When the flip-flop is "off" ("not" side true), the resistor is out of the circuit. Therefore, as a decade is counted up, resistance is added in parallel and DAC current increases at each step.

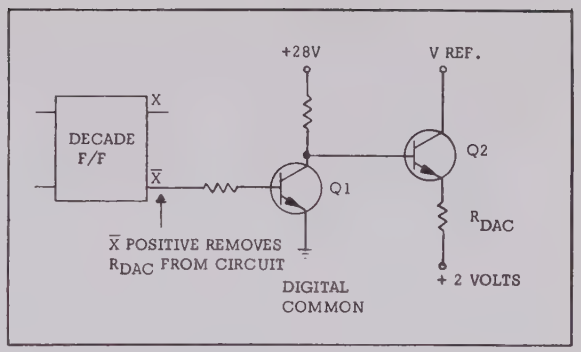


Figure 4.6. Typical DAC Switch

4.18. The positive DAC current is applied to the summing junction at the Null Detector input. If the DAC current is greater than the negative current from the Signal Conditioning module, the resulting current is positive; if the Signal Conditioning input is greater, the resulting current is negative. The Null Detector is a high-gain amplifier that provides an output of sufficient amplitude to trigger the Trigger flip-flop only when the input (summing junction) is negative. The Trigger flip-flop is located on the Sequence Logic board; its output is the UP signal. UP and its complement, $\overline{UP}$, control generation of the sequence states which, in turn control the counting operation of the Decades.

4.19 DECADES (Schematic 430390)

4.20. There are four Decade boards in the instrument, all identical. The Decade board nearest the front of the instrument controls the 1000 digit; the 100 digit; the third, the 10 digit; and the fourth, the 1 digit.

4.21. At the beginning of a conversion, after the Start/Stop and Delay flip-

flops are set, the S9 line is made "true". This applies a positive voltage through R to the reset side of each flip-flop. This voltage sets each flip-flop and represents the 09999 condition. If the Null Detector indicates that 9999 is greater than the input signal, the Sequence Logic places the instrument in sequence state 1 (S1). S1 is applied to the C_O input of the 1K Decade. As S1 goes "true", the negative-going edge of $\overline{S1}$ places a negative voltage on the reset input of the flip-flop, thereby resetting it to zero. The "true" output of the flip-flop as it goes "false" (on negative-going edge). Each flip-flop on the 1K Decade is now "off" and the value represented by the four Decades has changed from 9999 to 0999. S1 is applied to the input gate along with UP and a clock pulse. The Decade counter now counts up on each clock pulse. (SX, shown on the diagram, represents S1 to the 1K Decade, S2 to the 100 Decade, S3 to the 10 Decade, and S4 to the 1 Decade). Counting continues until UP goes FALSE. At this time, the Sequence Logic places the instrument in sequence state 2 (S2) and the 100 Decade is reset by S2 applied to the C_O input. The count-up operation proceeds exactly as in the 1K Decade, except that the input gate is now enabled by S2. The 10 Decade and 1 Decade counting operations begin on following UP signals. At the end of the 1 Decade counting operation (S4), the Sequence Logic counter and Start/Stop flip-flop are reset and no further sequence states are generated until the Start/Stop flip-flop is again set.

4.22. The "and" gates at the inputs to the 2 and 2* flip-flops adjust the count to eliminate "forbidden codes". Additional logic on each decade detect the "zero" and "nine" states of the Decade for use of the range circuits in the Accessory Module.

4.23. Also included on the Decade circuit board is a Decoder that interprets the State of the flip-flops and produces the drive voltage for the numerical display and the BCD data to the Electrical Output accessory. There are five lines to the lamp, each representing a pair of numerals: 0 and 1, 2 and 3, 4 and 5, etc. Separate control lines determine whether the even or odd numeral is to be lit. During the digitizing cycle, a blanking signal inhibits both the odd and even enable lines.

4.24 SEQUENCE LOGIC
(Schematic 430348)

4.25. A counter on the Sequence Logic circuit board generates the four sequence states — of periods during which each Decade is reset to zero and then counted up. In addition, logic gates on the board determine when the sequence counter is turned on — and also detect the "overrange" condition where the input exceeds the four digit capability of that range. Operation of the Sequence Logic is described in the following paragraphs; in the first case, it is assumed that the input does not require the overflow function.

4.26. Initially, each Decade is set to nine, the Overflow flip-flop (on Control Logic board) is off, and each flip-flop in the sequence counter is off. In this assumed case, the value represented by the Decade setting of 9999 is greater than the input signal; therefore the Trigger flip-flop is not turned on and UP is "true." UP enables an "and" gate which causes the S1 (sequence

state 1) flip-flop to be set. Other inputs to the "and" gate are the clock Start/Stop, and the "false" side of the sequence counter flip-flops to assure that S1 is not set by any time other than at the start of a conversion.

4.27. As S1 goes "true", $\overline{S1}$ goes "false". The negative-going edge of $\overline{S1}$ enables the input gate to allow the Decade to start counting. The 1K Decade counts up until $\overline{UP}$ is received. $\overline{UP}$ resets the S1 flip-flop in the sequence counter. On the negative-going edge of S1, flip-flop S2 is set. The negative-going edge of $\overline{S2}$ resets the 100 Decade to zero. S2 enables the input gate of the 100 Decade and it begins counting.

4.28. The Sequence counter advances to S3 on the next $\overline{UP}$ and the 10 Decade count operation is performed. Then S4 controls the counting of the 1 Decade. The 10 and 1 Decades are set to zero by S2 and S3 rather than $\overline{S3}$ and $\overline{S4}$ since their negative-going edges occur at the same time; this eliminates the need of bringing out two extra leads from the board. The negative-going edge of S4 resets the Start/Stop flip-flop.

4.29. The function of each sequence state can be summarized as follows:

- $\overline{S1}$ resets 1K Decade to zero (on negative-going edge);
- S1 enables 1K Decade count-up;
- $\overline{S2}$ resets 100 Decade to zero (on negative-going edge);
- S3 enables 10 Decade to zero (on negative-going edge);
- S4 enables 1 Decade count-up, and resets start/stop flip-flop (on negative-going edge).

4.30. The overrange condition exists when, after the Decades are initially set to 9999, an UP is received. This indicates that the value represented by the state of the Decades is full-scale but still less than the input signal. This condition is detected by an "and" gate on the Sequence Logic board which received the UP signal along with the clock, Start/Stop, and the "not" outputs of the sequence counter flip-flops. When UP enables this gate, a signal (Set 10K) is sent to the Control Logic board where it sets the overflow flip-flop. The overrange bit has a logical weight of 10,000. If the overrange bit is "true", the readout is 10XXX. For reasons of linearity and accuracy, the analog weight of the resistor associated with this bit is 1000. This requires that the 1K decade be set to 9; this results in a total weight of 9 + 1 or 10. The readout does not indicate 19999, but the true analog weight of 10999.

4.31. If, after the overrange bit is set, the new comparison at the Null Detector results in an $\overline{UP}$, this indicates that the input is some value between 9999 and 10999. The negative-going edge of $\overline{10K}$ places the instrument into sequence state 3 and the conversion proceeds as described before, but with the 1K position remaining at 9 and the 100 Decade the first Decade "dropped".

4.32. If, after the overflow bit is set, an UP is received — indicating that 10999 is still less than the input, a digitizing cycle is performed and the unit is made to up-range (if instrument equipped for auto range). If no higher range is available, the overrange indication of 10999 is displayed (printed) to indicate an excessive input.

4.33 CONTROL LOGIC
(Schematic 430686)

4.34. The conversion operation begins when the Start/Stop flip-flop is set. Start/Stop is set either automatically, by the Display Rate circuit, or by an external command.

4.35. The Display Rate circuit is an oscillator which delivers a pulse every 250 milliseconds when the READ/HOLD switch is in the READ position. The oscillator output is inverted and applied to an "and" gate. The gate is inhibited by Ground Hold when the READ/HOLD switch is in HOLD — or by Accessory Hold if the line is at ground level. The Start/Stop flip-flop is set on the negative-going edge of the Display Rate signal. Start/Stop is also set when an external command is received through the programming input or by Accessory Command.

4.36. As Start/Stop (S/S) is set, the negative-going edge of $\overline{S/S}$ sets the Reset flip-flop. RESET is applied through an inverter to the Decades as S9 (Set 9). It sets the Decades to 9999 and resets the Overflop flip-flop to zero. The Reset flip-flop is turned off by the next CLOCK.

4.37. The "true" output of the Start/Stop flip-flop is applied to an inverter. The inverter output is the blanking level which biases off the display lamps during the digitizing process. At the end of a conversion, Start/Stop is turned off by S7 (negative-going). This releases the blanking signal and, at that time, the state of the Decades is displayed.

4.38. The Overflow flip-flop is set by the Set 10K signal from the Sequence Logic board. Its output operates a corresponding DAC switch in the Null Detector representing a "1" digit in the 10K position. This feature allows an overrange voltage to be measured and displayed.

4.39. REFERENCE AND BUFFER AMPLIFIER (Schematic 430350)

4.40. The Reference and Buffer Amplifier board serves two functions: it produces a precise 10-volt internal reference output for absolute measurements, and it serves as a high-input impedance, low-output impednace, unity-gain, buffer amplifier for external reference voltages used in ratio measurements. A relay on the board (K1) switches the circuit from internal reference to external buffer when energized by the RATIO command from the FUNCTION switch or through the remote programming accessory. The internal reference circuit is based on the use of an aged Zener diode and is a divider network consisting of a fixed resistor, a potentiometer, and the Zener diode. The drive current for the Zener comes from the output of the Reference Buffer itself. Through careful selection of components and a balancing of the various resistances in the feedback network, an essentially zero temperature coefficient is achieved within the operating range of the instrument.

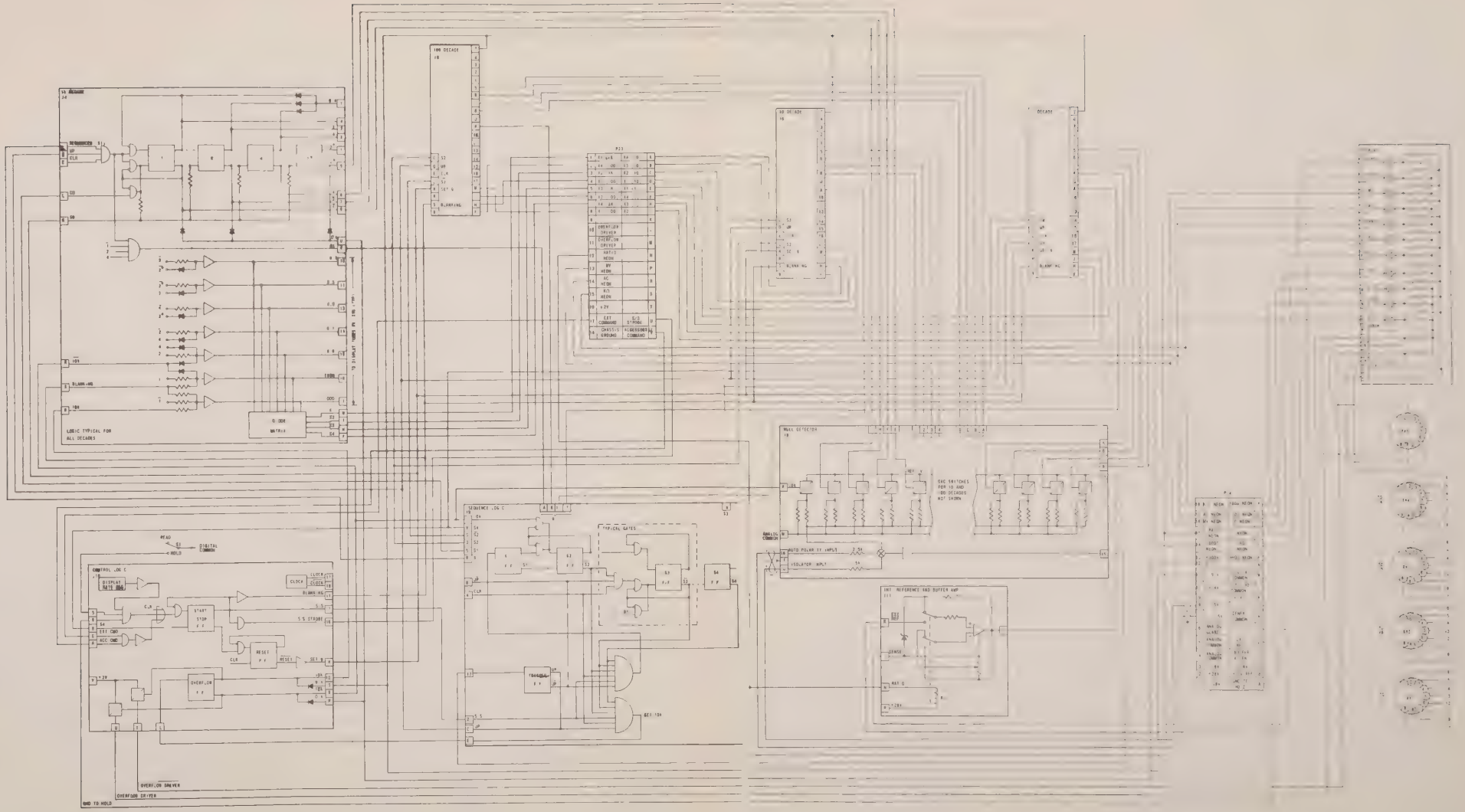


Figure 4.6. Functional Intraconnection, Digitizing and Display Module

Section 5

Recalibration

Recalibration of the Model 5400 Digital Voltmeter involves only adjustments within the accessory module. Refer to the appropriate accessory module instruction manual for procedures.

Section 6

Drawings

6.1 DRAWINGS

The following drawings are included in this section:

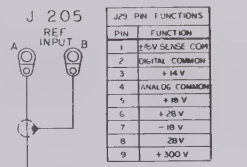
Wiring Diagram - Interconnection 5400	430311
Wiring Diagram - Interconnection 5403	430397
Wiring Diagram - Intraconnection	430362
Wiring Diagram - Intraconnection	430687*
PC Board Assembly - Display	400691
Schematic - Display	430301
PC Board Assembly - Basic Decade	400862
Schematic - Basic Decade	430363
PC Board Assembly - Basic Decade	400891*
Schematic - Basic Decade	430390*
PC Board Assembly - Null Detector	400843
Schematic - Null Detector	430351
PC Board Assembly - Sequence Logic	400688
Schematic - Sequence Logic	430348
PC Board Assembly - Control Logic	400689
Schematic - Control Logic	430349
PC Board Assembly - Control Logic	402502*
Schematic - Control Logic	430686*
PC Board Assembly - Reference and Buffer Amplifier	400840
Schematic - Reference and Buffer Amplifier	430350
Rear Panel Assembly - 5400	400684
PC Board Assembly - Power Supply - 5400	400707
Schematic - Power Supply - 5400	430318
Wiring Diagram - Rear Panel - 5400-1	430613
Power Supply Assembly - 5403	402000
PC Board Assembly - Power Supply - 5403	402316
Assembly - Capacitor - 5403	402019
Schematic - Power Supply - 5403	430571

*Used on later production runs

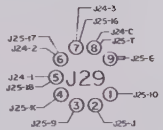
6.2 PARTS LISTS

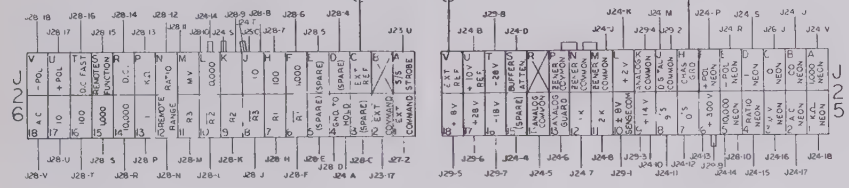
Parts Lists follow the drawings in the same sequence in which the drawings are listed.

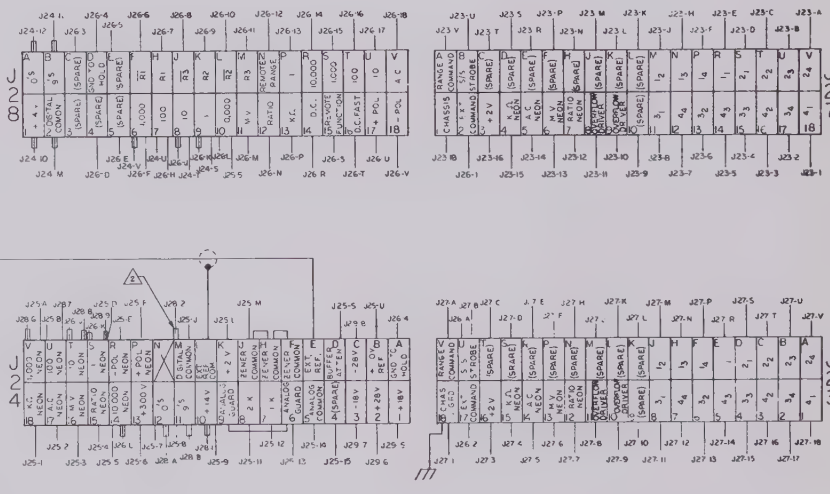
17



J29 PIN FUNCTIONS	
PIN	FUNCTION
1	+6 V SENSE COM
2	DIGITAL COMMON
3	+ 14 V
4	ANALOG COMMON
5	+ 18 V
6	+ 28 V
7	− 18 V
8	28 V
9	+ 300 V







⚠2 LEADS INDICATED THUS: CONSIST PARTIALLY OF 22 GA. TINNED BUS WIRE (P/N 500004) INSULATED WITH 20 GA. TEFLON SLEEVING (P/N 501376).

L CONNECTORS SHOWN AS VIEWED FROM REAR OF INSTRUMENT; THUS J23, J24, J25 & J26 ARE ON FAR SIDE OF INTERCONNECTION BOARD; J27, J28 & J29 ARE ON NEAR SIDE.

NOTES: UNLESS OTHERWISE SPECIFIED

QTY REQD	SYM	ITEM NO.	GOV'T OR VENDOR NO.	DANA PART NUMBER	NOMENCLATURE OR DESCRIPTION	CODE IDENT	SPECIFICATION

LIST OF MATERIAL OR PARTS LIST

MATERIAL

APPLIED FINISH

HEAT TREATMENT

UNLESS OTHERWISE SPECIFIED
DIMENSIONS ARE IN INCHES
TOLERANCES ON
DECIMALS | ANGLES
.X ± .030 | ± 0° 30'
.XX ± .020
.XXX ± .010
FORMED ANGLES ± 1°
ECCENTRICITY BETWEEN DIA ON THE SAME AXIS SHALL NOT EXCEED .010 TIR.
INTERPRET DRAWING IN ACCORDANCE WITH STANDARDS MIL-D-1000 AND MIL-D-70327

CONTRACT NO.

	NAME	DATE
DR	W. Eoff	Nov 1965
CHK	[illegible]	12-6-65
APPD	[illegible]	12-10-65

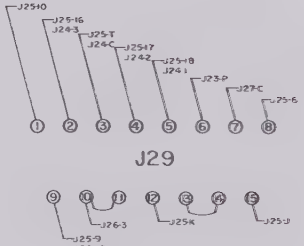
DANA LABORATORIES INC.
IRVINE, CALIFORNIA

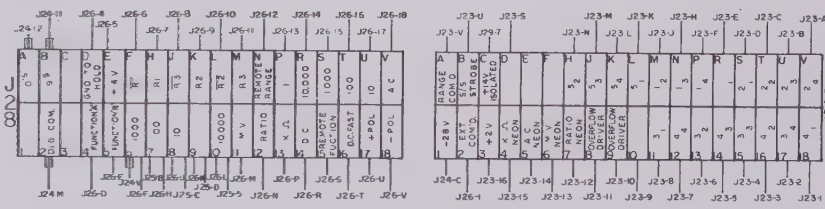
WIRING DIAGRAM - INTERCONNECTION

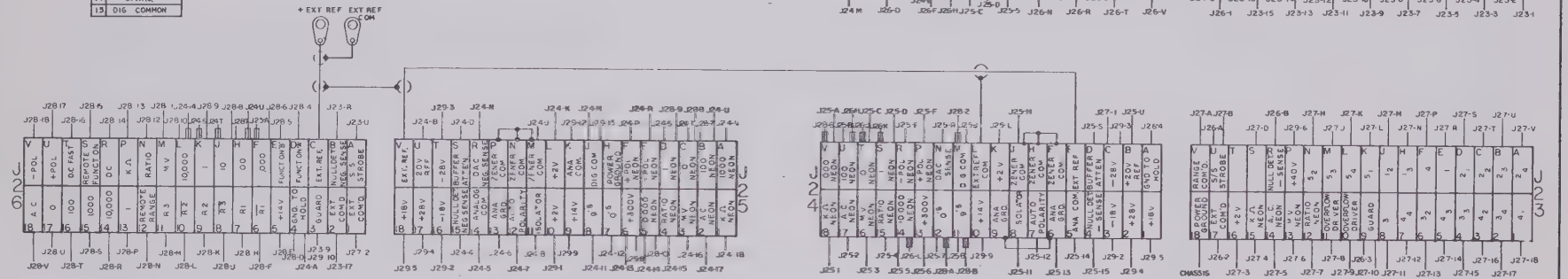
SIZE	CODE IDENT NO.	DWG NO.
D	—	430311 H

SCALE — WT — SHEET 1 OF 1

J29 PIN FUNCTIONS	
PIN	FUNCTION
1	+2 V
2	−18 V
3	−28 V
4	+28 V
5	+18 V
6	+40 V
7	+14V ISOLATED
8	+300 V
9	+14 V
10	GUARD
11	GUARD
12	ANA. COMMON
13	SPARE
14	SPARE
15	DIG COMMON







2. LEADS INDICATED THUS: CONSIST PARTIALLY OF 22 GA TINNED BUSS WIRE (P/N 500804) INSULATED WITH 20 GA TEFLON SLEEVING (P/N 501376).

1. CONNECTORS SHOWN AS VIEWED FROM REAR OF INSTRUMENT: THUS J 23, J 24, J 25 AND J 26 ARE ON FAR SIDE OF INTERCONNECTION BOARD; J 27, J 28 AND J 29 ARE ON NEAR SIDE.

NOTES: UNLESS OTHERWISE SPECIFIED

QTY REQD	SYM	ITEM NO.	GOV'T OR VENDOR NO.	DANA PART NUMBER	NOMENCLATURE OR DESCRIPTION	CODE IDENT	SPECIFICATION

LIST OF MATERIAL OR PARTS LIST

NEXT ASSY	USED ON	MA	FA
702001	SY. 3/7500	261	REF
APPLICATION		QTY REQD	

MATERIAL

APPLIED FINISH

HEAT TREATMENT

UNLESS OTHERWISE SPECIFIED
DIMENSIONS ARE IN INCHES
TOLERANCES ON DECIMALS: X ± .030, XX ± .020, XXX ± .010; ANGLES ± 0° 30'
FORMED ANGLES ± 1.0°
ECCENTRICITY BETWEEN DIA ON THE SAME AXIS SHALL NOT EXCEED .010 TIR.
INTERPRET DRAWING IN ACCORDANCE WITH STANDARDS MIL-D-1000 AND MIL-D-70327

CONTRACT NO.

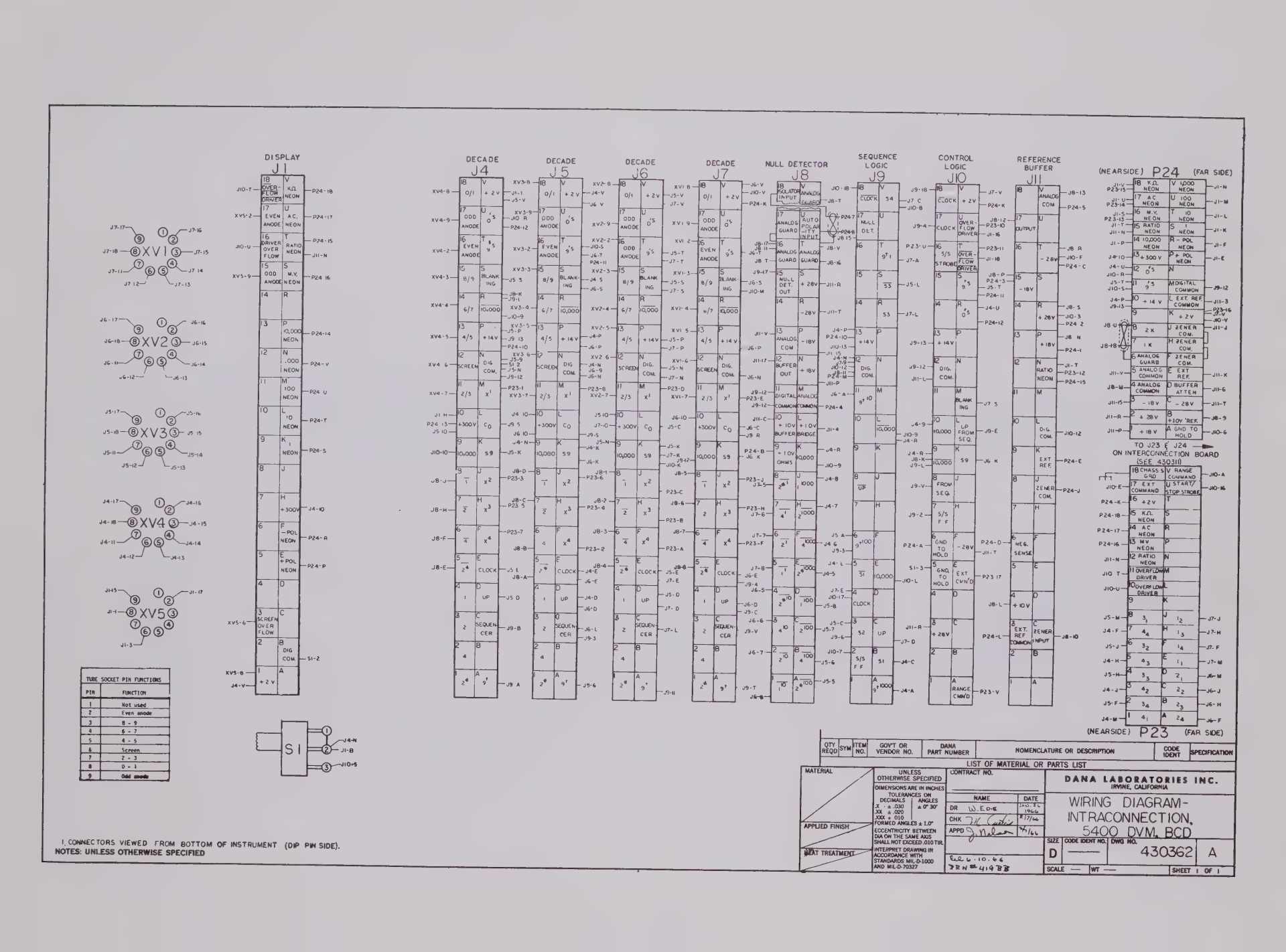
	NAME	DATE
DR	A CHAUSSEE	4 21 66
CHK	M Curtis	4/25/66
APPD		

DANA LABORATORIES INC.
IRVINE, CALIFORNIA

WIRING DIAGRAM - INTERCONNECTION.

SIZE D | CODE IDENT NO. | DWG NO. 430397

SCALE —— | WT —— | SHEET 1 OF 1



TUBE SOCKET PIN FUNCTIONS	
PIN	FUNCTION
1	Not used
2	Even anode
3	8 - 9
4	6 - 7
5	4 - 5
6	Screen
7	2 - 3
8	0 - 1
9	Odd anode

1. CONNECTORS VIEWED FROM BOTTOM OF INSTRUMENT (DIP PIN SIDE).

NOTES: UNLESS OTHERWISE SPECIFIED

QTY REQD	SYM	ITEM NO.	GOVT OR VENDOR NO.	DANA PART NUMBER	NOMENCLATURE OR DESCRIPTION	CODE IDENT	SPECIFICATION

LIST OF MATERIAL OR PARTS LIST

MATERIAL

APPLIED FINISH

HEAT TREATMENT

UNLESS OTHERWISE SPECIFIED
DIMENSIONS ARE IN INCHES
TOLERANCES ON
DECIMALS: .X ± .030, .XX ± .020, .XXX ± .010
ANGLES: ± 0° 30'
FORMED ANGLES ± 1.0°
ECCENTRICITY BETWEEN DIA ON THE SAME AXIS SHALL NOT EXCEED .010 TIR.
INTERPRET DRAWING IN ACCORDANCE WITH STANDARDS MIL-D-1000 AND MIL-D-70327

CONTRACT NO.

	NAME	DATE
DR	W. E. O'E	12-15-65 1966
CHK	W. Curtis	1/17/66
APPD	J. Nelson	2/1/66

REV 6.10.66
PRN # 41988

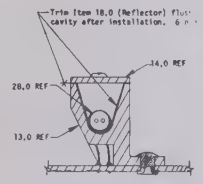
DANA LABORATORIES INC.
IRVINE, CALIFORNIA

WIRING DIAGRAM - INTRACONNECTION, 5400 DVM, BCD

SIZE	CODE IDENT NO.	DWG NO.	
D	———	430362	A

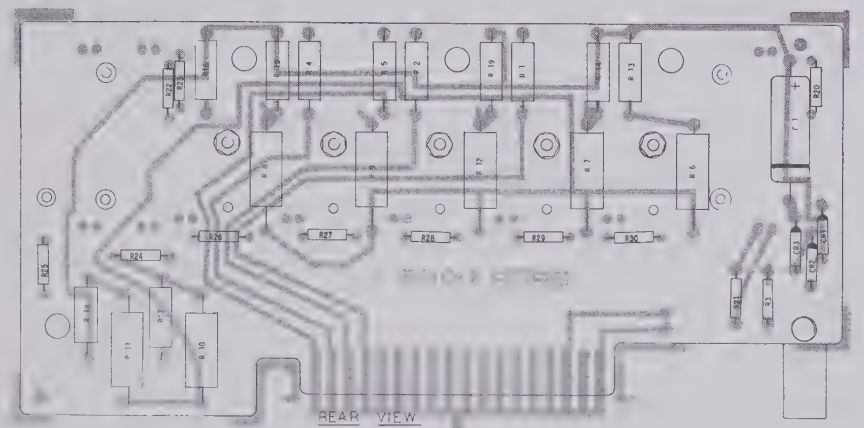
SCALE — WT — SHEET 1 OF 1

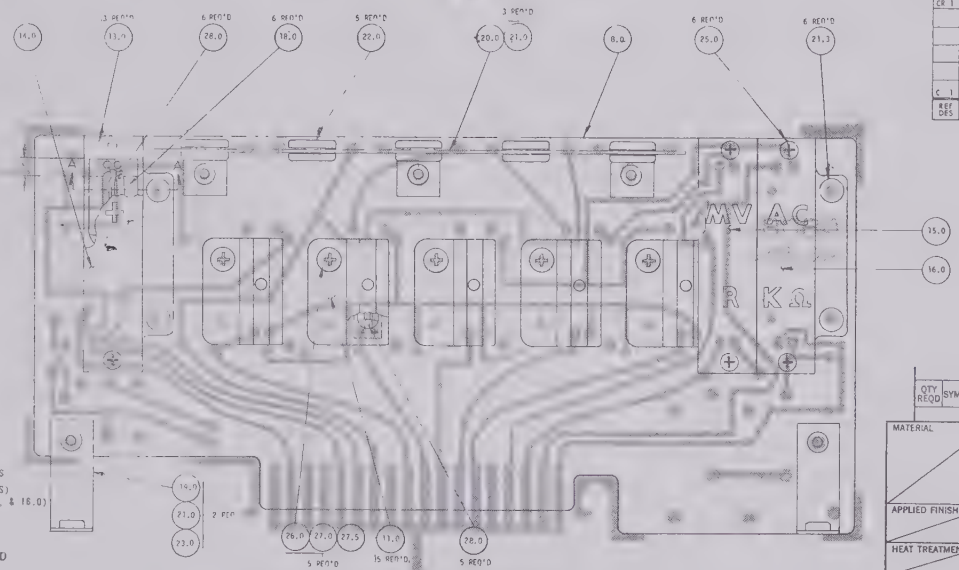
DISPLAY
J1
DECADE
J4
DECADE
J5
DECADE
J6
DECADE
J7
NULL DETECTOR
J8
SEQUENCE LOGIC
J9
CONTROL LOGIC
J10
REFERENCE BUFFER
J11
XV1
XV2
XV3
XV4
XV5
S1
P24
P23
TUBE SOCKET PIN FUNCTIONS
PIN FUNCTION
1 Not used
2 Even anode
3 8 - 9
4 6 - 7
5 4 - 5
6 Screen
7 2 - 3
8 0 - 1
9 Odd anode
1. CONNECTORS VIEWED FROM BOTTOM OF INSTRUMENT (DIP PIN SIDE).
NOTES: UNLESS OTHERWISE SPECIFIED
REVISIONS
LTR DESCRIPTION DATE APPROVED
SYM ITEM NO. GOVT OR VENDOR NO. DANA PART NUMBER NOMENCLATURE OR DESCRIPTION CODE IDENT SPECIFICATION
LIST OF MATERIAL OR PARTS LIST
UNLESS OTHERWISE SPECIFIED
DIMENSIONS ARE IN INCHES
TOLERANCES ON DECIMALS ANGLES
X ± .030 ± 0° 30'
XX ± .020
XXX ± .010
FORMED ANGLES ± 1.0°
ECCENTRICITY BETWEEN DIA ON THE SAME AXIS SHALL NOT EXCEED .010 TIR.
INTERPRET DRAWING IN ACCORDANCE WITH STANDARDS MIL-D-1000 AND MIL-D-70277
APPLIED FINISH
HEAT TREATMENT
NEXT ASSY USED ON NA FA
APPLICATION QTY REQD
CONTRACT NO.
NAME DATE
DR Jan Curtis 9 Aug 1962
CHK
APPD E.U. Cook 15 Aug 62
DANA LABORATORIES INC.
IRVINE, CALIFORNIA
WIRING DIAGRAM-
INTRACONNECTION,
DVM, BCD
SIZE CODE IDENT NO. DWG NO.
D 21793 430687
SCALE --- WT SHEET 1 OF 1



SECTION A-A
TYPICAL 3 PLACES

CROSS REFERENCE CHART	
ITEM NO.	PART NO.
8.0	410183
11.0	450784
13.0	450788
14.0	450873
15.0	450674
16.0	450875
18.0	450676
19.0	450909
20.0	450890
21.0	61...
21.3	C10012
22.0	610017
23.0	610177
25.0	617201
26.0	615468
27.0	617016
27.5	617...7
28.0	926116





REF DES	B/M ITEM	DESCRIPTION
R 19	5.0	130K 1 W
Thru		
R 13	5.0	130K 1 W
R 12	4.0	100 K 2 W
Thru		
R 6	4.0	100 K 2 W
R 5	3.0	20 K 1 W
R 4	2.0	39 K 1 W
R 3	1.0	220 K 1/4W
R 2	3.0	20 K 1 W
R 1	2.0	39 K 1 W
CR 3	7.0	SD 4
CR 1	7.0	SD 4
C 1	6.0	250 MFD 6V

REF DES	B/M ITEM	DESCRIPTION
R30	1.5	910 K
THRU		
R20	1.5	910 K

4 SCHEMATIC REFERENCE: 430301
3 ASSEMBLY PROCEDURES AND PROCESSES TO CONFORM TO DANA WORKMANSHIP STANDARDS
2 INDICATOR TUBE ON ITEM 11.0 (5 PLACES) AND DISPLAY SCREENS (ITEM 14.0, 15.0, & 16.0) TO BE MASKED BEFORE " HUMI SEAL".
1 ALL NEON LAMPS ARE NE-211

NOTES: UNLESS OTHERWISE SPECIFIED

QTY REQD	SYM	ITEM NO.	GOV'T OR VENDOR NO.	DANA PART NUMBER	NOMENCLATURE OR DESCRIPTION	CODE IDENT	SPECIFICATION

LIST OF MATERIAL OR PARTS LIST

MATERIAL
APPLIED FINISH
HEAT TREATMENT

UNLESS OTHERWISE SPECIFIED
DIMENSIONS ARE IN INCHES
TOLERANCES ON DECIMALS: X ± .030, XX ± .020, XXX ± .010
ANGLES ± 0° 30'
FORMED ANGLES ± 1.0°
ECCENTRICITY BETWEEN DIA ON THE SAME AXIS SHALL NOT EXCEED .010 TIR.
INTERPRET DRAWING IN ACCORDANCE WITH STANDARDS MIL-D-1000 AND MIL D-70327

CONTRACT NO.

	NAME	DATE
DR	[illegible]	11-9-65
CHK	[illegible]	11-10-65
APPD	[illegible]	

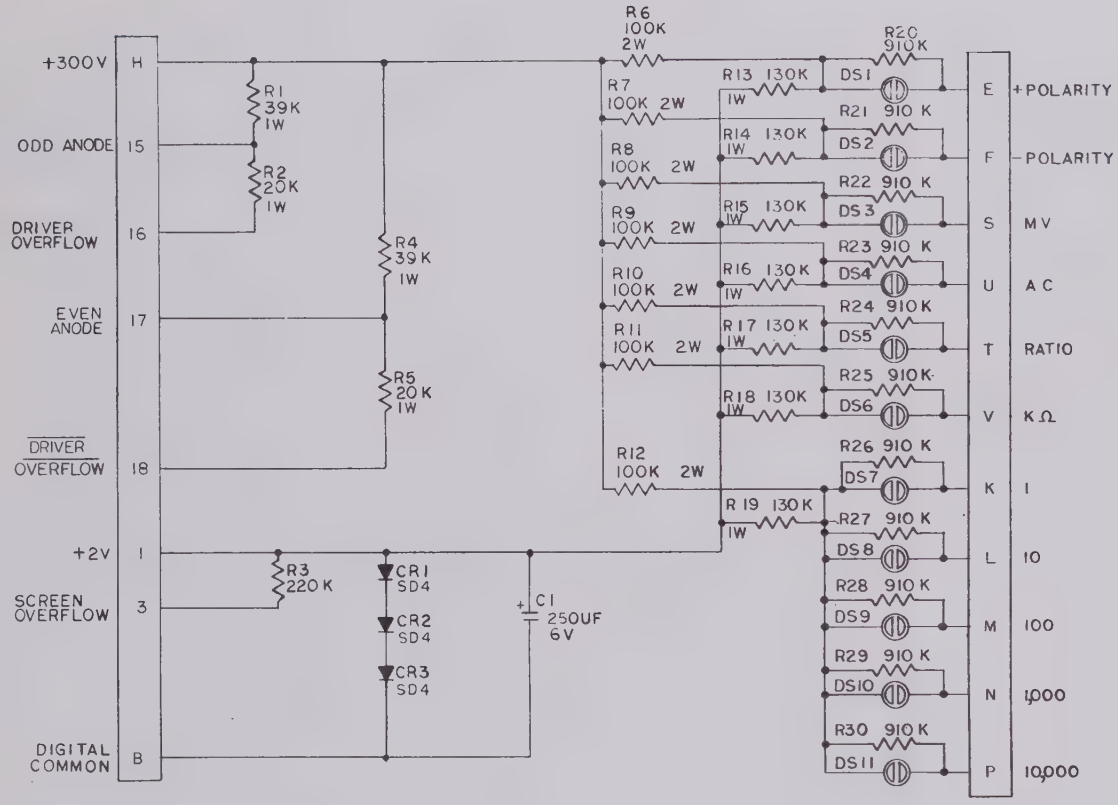
P.O. 11-19-65
DRN # 207 30

DANA LABORATORIES INC.
IRVINE, CALIFORNIA

P C BOARD ASS'Y - DISPLAY

SIZE	CODE IDENT NO.	DWG NO.	
D		400691	K

SCALE 2 : 1 | WT | SHEET 1 OF 1



QTY REQD	SYM	ITEM NO.	GOV'T IDENT NO.	DANA PART NUMBER	NOMENCLATURE OR DESCRIPTION	SPECIFICATION
400691					754 COUPLER	REF
400691					HARDY SCALES	REF
400691					5503 SER DVM	REF
400691					5400 SER DVM	REF

LIST OF MATERIALS OR PARTS LIST

NEXT ASSY	USED ON	NEXT ASSY	FINAL ASSY
APPLICATION		QTY REQD	

SYMBOLS
APPLICABLE TO DANA LABORATORIES INC. ONLY
SA.....SUB- ASSY MRA.....MAJOR REPL ASSY
MA.....MODULE ASSY CA.....COMPLETE ASSY

3 HIGHEST REFERENCE DESIGNATORS ARE:
R30
DS11
CR4
C1

2. ALL NEON LAMPS ARE NE-2H
1. ALL RESISTORS 1/4W, 5%, CARBON
NOTES: UNLESS OTHERWISE SPECIFIED

UNLESS OTHERWISE SPECIFIED
DIMENSIONS ARE IN INCHES
TOLERANCES ON
DECIMALS .X ±.030 .XX ±.020 .XXX ±.010
ANGLES ± 0° 30'

MATERIAL

APPLIED FINISH

DRAWN		10-18-65
CHECK		19 OCT 65
ENGR		21 OCT 65
APPR		

APPROVED

APPROVED

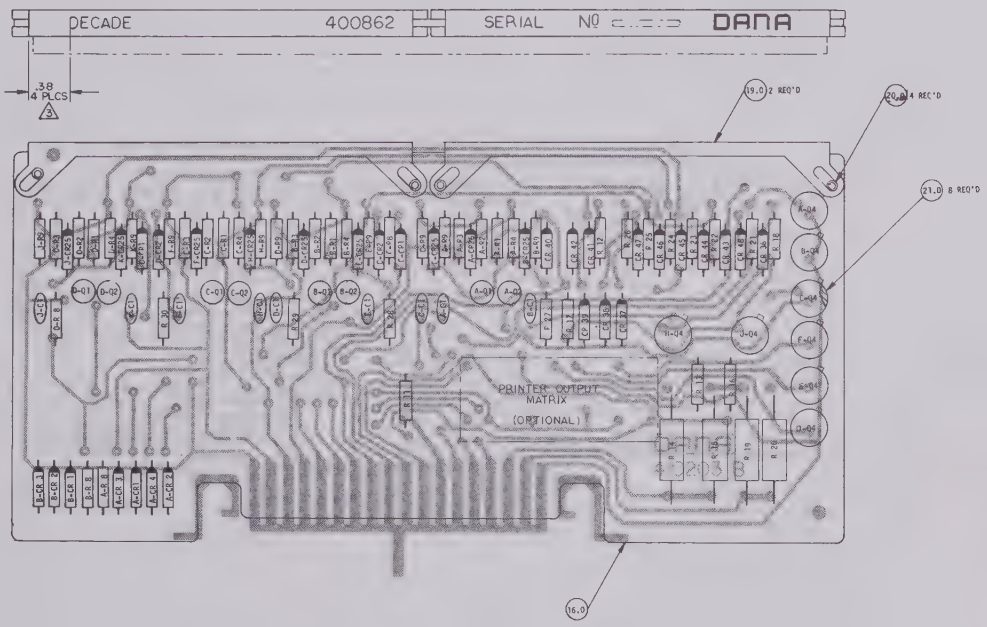
ben 11-19-65
Dir. # 117

DANA LABORATORIES INC.
IRVINE, CALIFORNIA

SCHEMATIC —
DISPLAY

CODE IDENT NO.	SIZE		
	C	430301	F
SCALE	WEIGHT	SHEET 1 OF 1	

F 430301



REF DES	B/M ITEM	DESCRIPTION
R 2	3.0	15 K
D-R3	5.0	2.2 K
D-R3		
C-R3		
C-R1		
B-R3		
B-R1	5.0	2.2 K
A-R3	2.0	1.2 K
A-R1	2.0	1.2 K
Q 4	13.0	014
Q 2	14.0	2N3646
Q 1	14.0	2N3646
CR48	15.0	1N662
THRU		
CR36	15.0	1N662
CR25	15.0	1N662
CR 4	15.0	1N662
CR 3	15.0	1N662
CR 2	15.0	1N662
CR 1	15.0	1N662
C 1	12.0	33 mf

REF DES	B/M ITEM	DESCRIPTION
R 30	6.0	22 K
THRU		
R 27	6.0	22 K
R 26	9.0	33 K
THRU		
R 21	9.0	33 K
R 20	11.0	20 K, 1W
R 19	10.0	39 K, 1W
R 18	1.0	10 K
R 17	1.0	10 K
R 16	1.0	10 K
R 15	10.0	39 K, 1W
R 14	11.0	20 K, 1W
R 13	1.0	10 K
R 12	1.0	10 K
R 11	4.0	200 K
R 9	8.0	27 K
R 8	7.0	24 K
R 4	3.0	15 K

CROSS REFERENCE CHART	
ITEM NO.	PART NO.
16.0	410203 B
19.0	510235
20.0	510237
21.0	920006

QTY REQD	SYM	ITEM NO.	GOV'T OR VENDOR NO.	DANA PART NUMBER	NOMENCLATURE OR DESCRIPTION	CODE IDENT	SPECIFICATION

LIST OF MATERIAL OR PARTS LIST

MATERIAL

APPLIED FINISH

HEAT TREATMENT

UNLESS OTHERWISE SPECIFIED
DIMENSIONS ARE IN INCHES
TOLERANCES ON
DECIMALS: X ± .030, .XX ± .020, .XXX ± .010
ANGLES ± 0° 30'
FORMED ANGLES ± 1.0°
ECCENTRICITY BETWEEN DIA ON THE SAME AXIS SHALL NOT EXCEED .010 TIR.
INTERPRET DRAWING IN ACCORDANCE WITH STANDARDS MIL-D-1000 AND MIL-D-70327

CONTRACT NO.

	NAME	DATE
DR		28 JAN 1966
CHK		29 JAN 1966
APPD		

Rel 6.10.66
DEN #41688

DANA LABORATORIES INC.
IRVINE, CALIFORNIA

P.C. BOARD ASS'Y-
DECADE, BCD, BASIC

SIZE	CODE IDENT NO.	DWG NO.	
D	——	400862	B

SCALE 2/1 | WT —— | SHEET / OF /

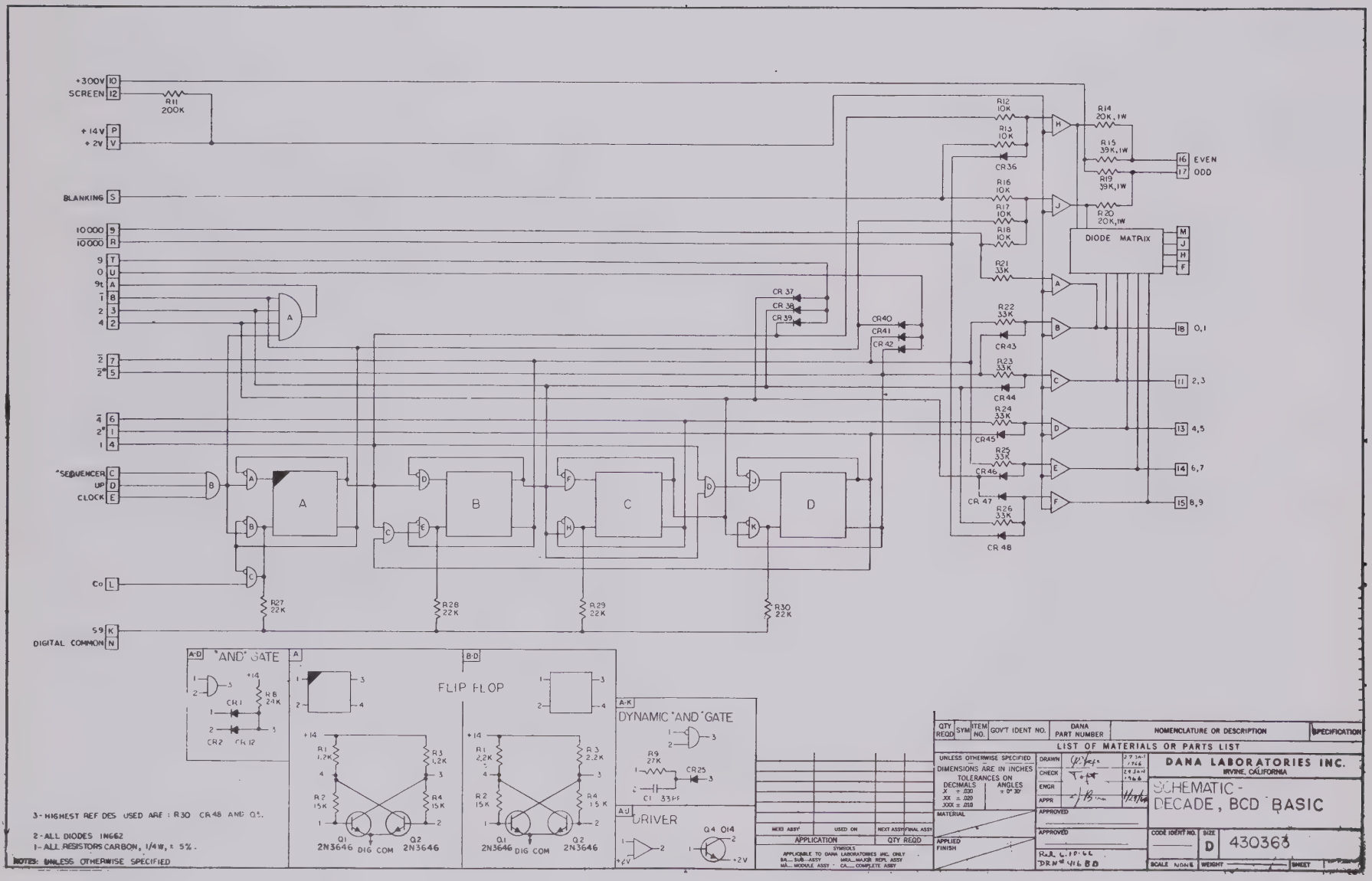
4. ASSEMBLY PROCEDURES AND PROCESSES TO CONFORM WITH DANA WORKMANSHIP STANDARDS

(3) Heat stamp .10 high black characters and .15 high tags, located as shown.

2. Diodes to be 1N662

1. Resistors to be 1/4W, ± 5%, Carbon

NOTES: UNLESS OTHERWISE SPECIFIED



3- HIGHEST REF DES USED ARE : R30 CR48 AND Q5.

2- ALL DIODES IN662

1- ALL RESISTORS CARBON, 1/4W, ± 5%.

NOTES: UNLESS OTHERWISE SPECIFIED

QTY REQD	SYM	ITEM NO.	GOV'T IDENT NO.	DANA PART NUMBER	NOMENCLATURE OR DESCRIPTION	SPECIFICATION

LIST OF MATERIALS OR PARTS LIST

UNLESS OTHERWISE SPECIFIED
DIMENSIONS ARE IN INCHES
TOLERANCES ON
DECIMALS X ± .020 XX ± .010 XXX ± .010
ANGLES ± 0° 30'

DRAWN 27 JAN 1966
CHECK 28 JAN 1966
ENGR
APPR

MATERIAL
APPLIED FINISH
APPROVED
APPROVED

DRN # 416 BD

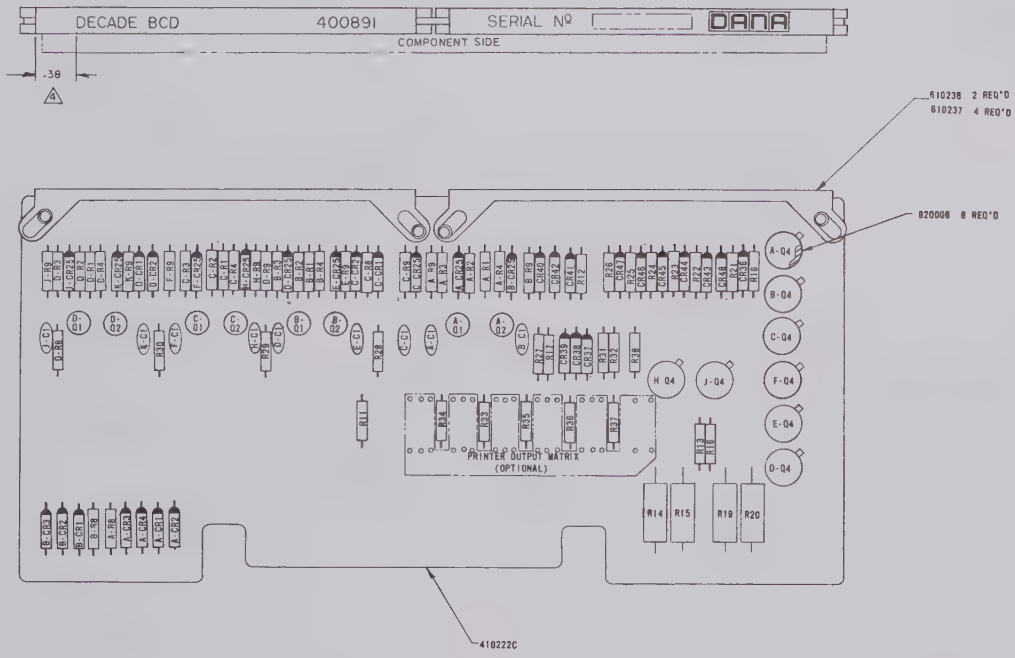
DANA LABORATORIES INC.
IRVINE, CALIFORNIA

SCHEMATIC - DECADE, BCD BASIC

CODE IDENT NO. | SIZE D | 430363
SCALE NONE | WEIGHT | SHEET

NEXT ASSY	USED ON	NEXT ASSY	FINAL ASSY
APPLICATION		QTY REQD	

SYMBOLS
APPLICABLE TO DANA LABORATORIES INC. ONLY
BA— SUB-ASSY MRU— MAJOR REPL ASSY
MA— MODULE ASSY CA— COMPLETE ASSY



REF DES	PART NO.	DESCRIPTION
R16	000103	10 K
R15	001107	39 K, 1 W
R14	001698	20 K, 1 W
R13	000103	10 K
R12	000103	10 K
R11	000204	200 K
R9	000273	27 K
R8	000243	24 K
R4	000153	15 K
R3	000122	1.2 K
R2	000153	15 K
R1	000122	1.2 K
Q4	200079	021
Q2	200037	2N3646
Q1	200037	2N3646
CR48	211083	018
↓	↓	↓
THRU		
↓	↓	↓
CR36	211083	018
CR25	211083	018
CR4	↓	↓
CR3		
CR2	↓	↓
CR1	211083	018
E-C1	100005	22PF DISC
C1	101182	47 PF DISC

REF DES	PART NO.	DESCRIPTION
R38	000204	200 K
R37	000473	47 K
↓	↓	↓
THRU		
↓	↓	↓
R33	000473	47 K
R32	000583	58 K
R31	000883	88 K
R30	000223	22 K
↓	↓	↓
THRU		
↓	↓	↓
R27	000223	22 K
R26	000103	10 K
↓	↓	↓
THRU		
↓	↓	↓
R21	000103	10 K
R20	001898	20 K, 1 W
R19	001107	39 K, 1 W
R18	000103	10 K
R17	000103	10 K

NEXT ASSY	USED ON	NA	FA
APPLICATION		QTY REQD	
402269	5500 BASIC	1	5
	5400 5203 BASIC	1	4
402357	MOD G1, P2	1	4
	73-E2, 75-E2	1	5
	63-E2, 65-E2	1	4
402342	MOD G1-P1	1	4
	73-E1, 75-E1	1	5
	63-E1, 65-E1	1	4
402343	MOD G1, M2	1	4
	73-02, 75-02	1	5
	63-02, 65-02	1	4
402162	MOD G1, M1	1	4
	73-01, 75-01	1	5
	63-01, 65-01	1	4

QTY REQD	DANA PART NUMBER	NOMENCLATURE OR DESCRIPTION	CODE IDENT	SPECIFICATION OR VENDOR P/N	ITEM NO.

LIST OF MATERIAL OR PARTS LIST

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES
TOLERANCES ON: DECIMALS X .030, XXX .010; ANGLES 0° 30'; FORMED ANGLES ±1°

MATERIAL

FINISH

CONTRACT NO.

DRAWN ABBOTT 1/1/67
CHECK 1/16/67
ENGR
COG. ENGR
PROJ ENGR 4/8/67

DRN 612
3-8-67

DANA LABORATORIES INC.
IRVINE, CALIFORNIA

PC BOARD ASSY — DECADE, BASIC

SIZE D | CODE IDENT NO. 21793 | DWG NO. 400891 | REV F

SCALE 2/1 | WT | SHEET 1 OF 1

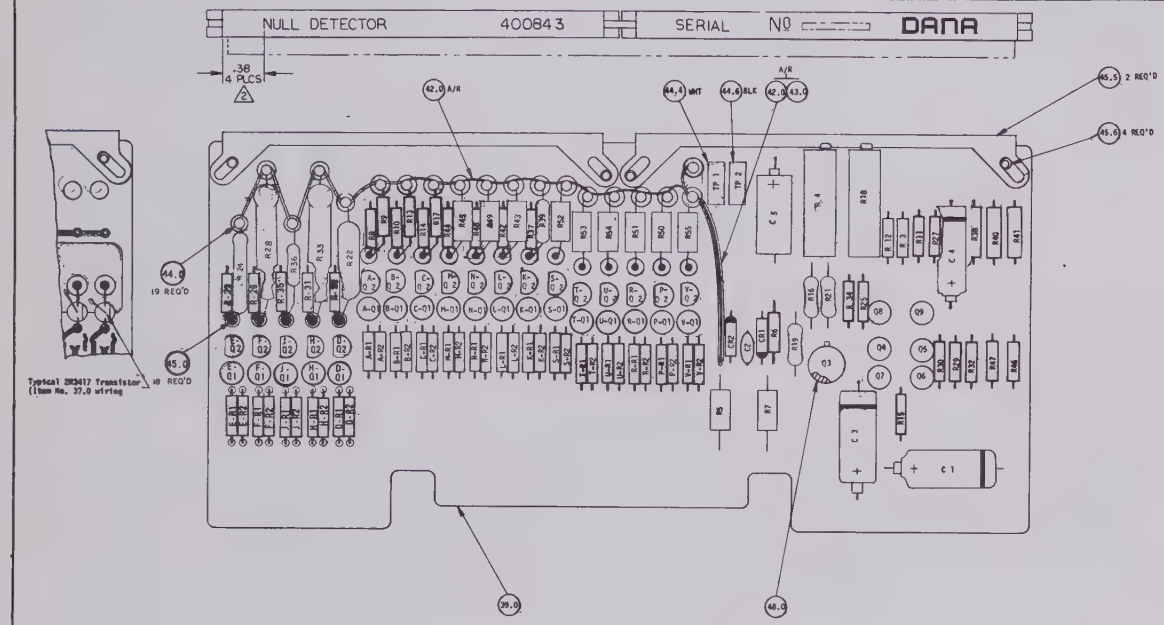
⚠ HEAT STAMP .10 HIGH BLACK CHARACTERS AND .15 HIGH LOGO, LOCATED AS SHOWN.

3. SCHEMATIC REFERENCE: 430300.

2. ASSEMBLY PROCEDURES AND PROCESSES TO CONFORM WITH DANA WORKMANSHIP STANDARDS.

1. ALL RESISTORS ARE 1/4 W, 2 %, CARBON.

NOTE: UNLESS OTHERWISE SPECIFIED



CROSS REFERENCE CHART	
ITEM NO	PART NO
29.0	410207 J
42.0	500004
43.0	501376
44.0	600030
44.4	600142
44.6	600144
45.0	500243
45.5	610236
45.6	610237
48.0	920082

REF DES	B/M ITEM	DESCRIPTION
R 24	21.0	5 Meg 1%
R 23	1.0	100K
R 22	20.0	12.5 Meg 1%
R 21	17.0	15 M RN60B
R 20	1.0	100 K
R 19	23.0	154 K 1%
R 18	30.0	POT 2 K E-Z TRIM
R 17	7.0	24 Meg
R 16	17.0	15 K RN60B
R 15	8.0	330 OHMS
R 14	1.0	100K
R 13	7.0	24 Meg
R 12	11.0	4.3 K
R 11	5.0	13 K
R 10	1.0	100 K
R 9	13.0	51 Meg
R 8	1.0	100 K
R 7	25.0	2400 OHM .01%
R 6	14.0	680 K
R 5	24.0	4948.22 OHM .01%
R 4	31.0	POT 5 K E-Z TRIM
R 3	5.5	200K
R 2	9.0	33 K
R 1	12.0	47 K
CR 2	38.0	038
CR 1	39.0	018
C 6	32.5	22 mf/36V
C 4	33.5	1 mfd 50 v
C 3	33.0	25 mfd 50 v
C 2	32.0	220 pf DISC
C 1	33.0	25 mfd 50 v

REF DES	B/M ITEM	DESCRIPTION
V-02	37.2	HIGH ORDER DAC (WHT)
THRU		
P-02	37.2	HIGH ORDER DAC (WHT)
N-02	37.3	LOW ORDER DAC (YEL)
THRU		
A-02	37.3	LOW ORDER DAC (YEL)
Q 1	35.0	2N3646
R 55	26.0	49.995 K .01%
R 54	27.0	24.995 K .01%
R 53	27.0	24.995 K .01%
R 52	26.0	49.995 K .01%
R 51	26.0	49.995 K .05%
R 50	28.0	125 K .05%
R 49	1.0	100 K
R 48	4.0	120 K
R 47	7.5	27 K
R 46	29.0	250 K .05%
R 45	1.0	100 K
R 44	29.0	250 K .05%
R 43	1.0	100 K
R 42	15.0	4.7 K 1/2 W
R 41	16.0	8.2 K 1/2 W
R 40	18.0	500 K .1%
R 39	15.0	4.7 K 1/2 W
R 38	1.0	100 K
R 37	23.3	1.25 Meg .1%
R 36	1.0	100 K
R 35	10.0	330 K
R 34	33.0	2.5 Meg .25%
R 33	3.0	12 K
R 32	1.0	100 K
R 31	2.0	11 K
R 30	6.0	2.4 K
R 29	22.0	2.5 Meg .25%
R 28	3.0	12 K
R 27	1.0	100 K
R 26	10.0	330 K
R 25		
C 9	36.0	2N3645
THRU		
C 4	36.0	2N3645
C 3	34.0	015

QTY REQD	SYM	ITEM NO.	GOV'T OR VENDOR NO.	DANA PART NUMBER	NOMENCLATURE OR DESCRIPTION	CODE IDENT	SPECIFICATION

LIST OF MATERIAL OR PARTS LIST

SCHEMATIC REFERENCE: 418351

ASSEMBLY PROCEDURES AND PROCESSES TO CONFORM WITH DANA WORKMANSHIP STANDARDS.

1. Heat Stamp .10 high block characters and .15 high Logo, Lasergg as shown
2. All Resistors 1/4 W, 5%, Carbon

NOTES: UNLESS OTHERWISE SPECIFIED

MATERIAL

APPLIED FINISH

HEAT TREATMENT

UNLESS OTHERWISE SPECIFIED
DIMENSIONS ARE IN INCHES
TOLERANCES ON DECIMALS: X ± .030, XX ± .020, XXX ± .010
ANGLES ± 0° 30'
FORMED ANGLES ± 1.0°
ECCENTRICITY BETWEEN DIA ON THE SAME AXIS SHALL NOT EXCEED .010 TIR.
INTERPRET DRAWING IN ACCORDANCE WITH STANDARDS MIL-D-1000 AND MIL-D-70327

CONTRACT NO.

NAME	DATE
DR	1 Feb 1966
CHK	10 Feb 1966
APPD	

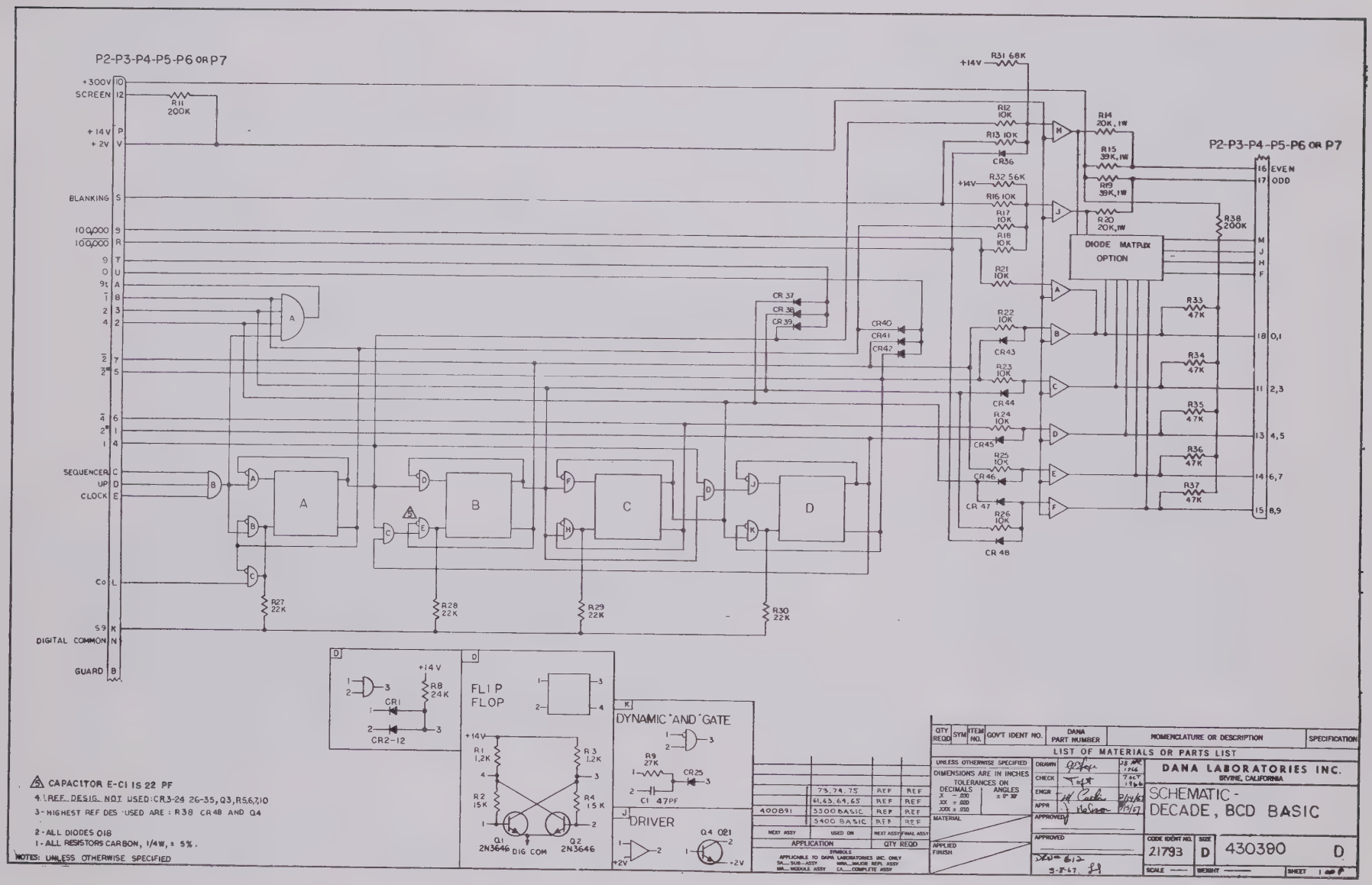
Feb 6-10-66
DRN 420 B

DANA LABORATORIES INC.
IRVINE, CALIFORNIA

PC BOARD ASSY -
NULL DETECTOR, 4 DIGIT

SIZE	CODE IDENT NO.	DWG NO.	
D	21793	400843	J

SCALE 2/1 WT SHEET 1 OF 1



⚠ CAPACITOR E-C1 IS 22 PF

4 - REF. DESIG. NOT USED: CR3-24 26-35, Q3, RS6, 7, 10

3 - HIGHEST REF DES USED ARE : R38 CR48 AND Q4

2 - ALL DIODES 018

1 - ALL RESISTORS CARBON, 1/4W, ± 5%.

NOTES: UNLESS OTHERWISE SPECIFIED

NEXT ASSY	USED ON	NEXT ASSY	FINAL ASSY
	73,74,75	REF	REF
	61,63,64,65	REF	REF
400891	5300 BASIC	REF	REF
	5400 BASIC	REF	REF

APPLICATION	QTY REQD

SYMBOLS
APPLICABLE TO DANA LABORATORIES INC. ONLY
SA—SUB—ASSY MA—MAJOR REPL ASSY
MA—MODULE ASSY CA—COMPLETE ASSY

QTY REQD	SYM	ITEM NO.	GOV'T IDENT NO.	DANA PART NUMBER	NOMENCLATURE OR DESCRIPTION	SPECIFICATION

LIST OF MATERIALS OR PARTS LIST

UNLESS OTHERWISE SPECIFIED
DIMENSIONS ARE IN INCHES
TOLERANCES ON DECIMALS X ± .030 XX ± .020 XXX ± .010
ANGLES ± 0° 30'

MATERIAL

APPLIED FINISH

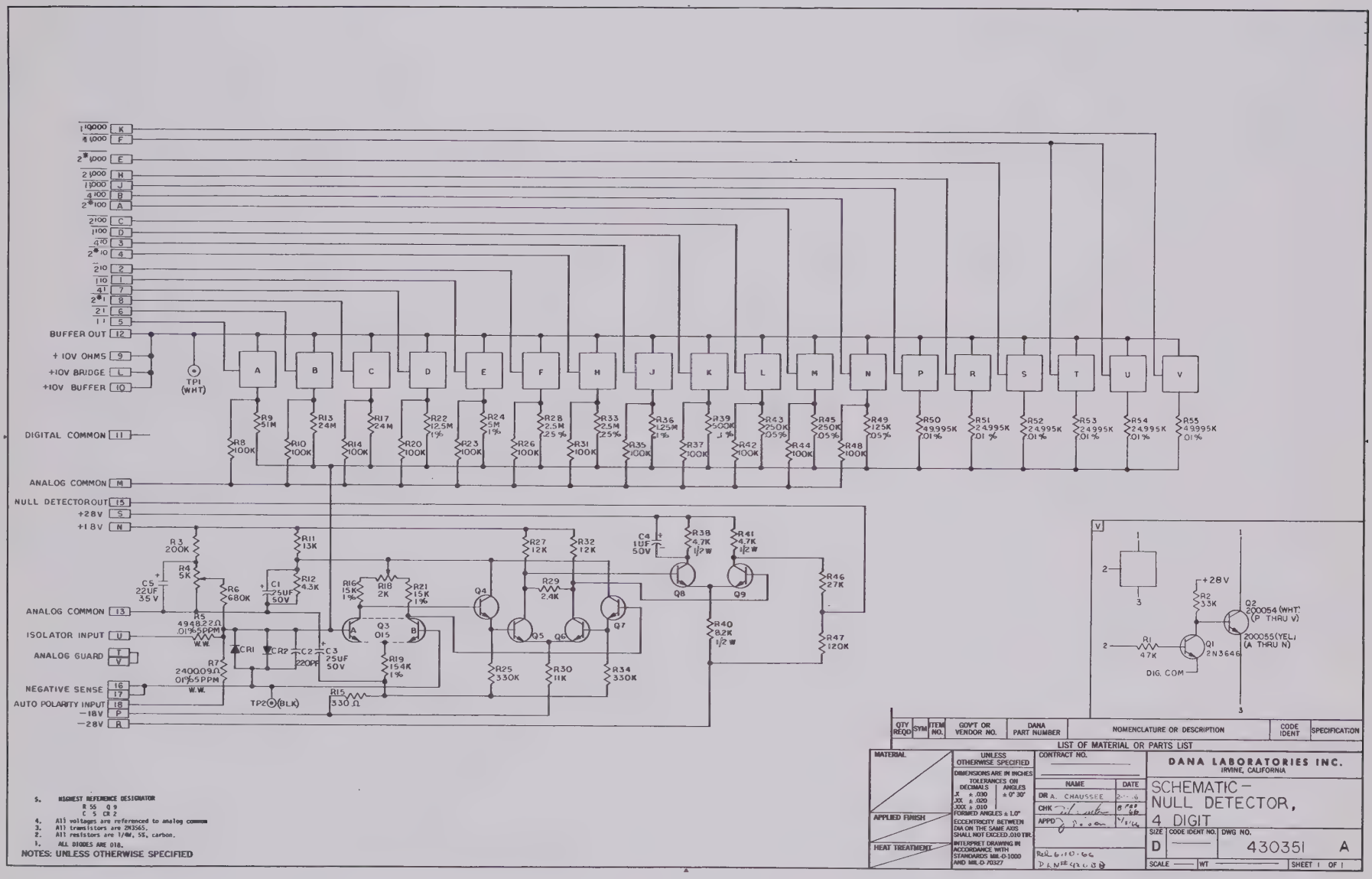
DRAWN 7-8-67
CHECK 7-8-67
ENGR 7-8-67
APPR 7-8-67
APPROVED
APPROVED 3-8-67

DANA LABORATORIES INC.
IRVINE, CALIFORNIA

SCHEMATIC - DECADE, BCD BASIC

CODE IDENT NO. 21793 | SIZE D | 430380 D

SCALE — | WEIGHT — | SHEET 1



5. HIGHEST REFERENCE DESIGNATOR
   R 55 Q 9
   C 5 CR 2
4. All voltages are referenced to analog common
3. All transistors are 2N3565.
2. All resistors are 1/4W, 5%, carbon.
1. ALL DIODES ARE 018.

NOTES: UNLESS OTHERWISE SPECIFIED

QTY REQD	SYM	ITEM NO.	GOVT OR VENDOR NO.	DANA PART NUMBER	NOMENCLATURE OR DESCRIPTION	CODE IDENT	SPECIFICATION

LIST OF MATERIAL OR PARTS LIST

MATERIAL
APPLIED FINISH
HEAT TREATMENT

UNLESS OTHERWISE SPECIFIED
DIMENSIONS ARE IN INCHES
TOLERANCES ON DECIMALS: X ± .030, XX ± .020, XXX ± .010; ANGLES ± 0° 30'
FORMED ANGLES ± 1.0°
ECCENTRICITY BETWEEN DIA ON THE SAME AXIS SHALL NOT EXCEED .010 TIR.
INTERPRET DRAWING IN ACCORDANCE WITH STANDARDS MIL-D-1000 AND MIL-D-70327

CONTRACT NO.

	NAME	DATE
DR	A. CHAUSSEE	2-10-66
CHK		2-10-66
APPD		2/10/66

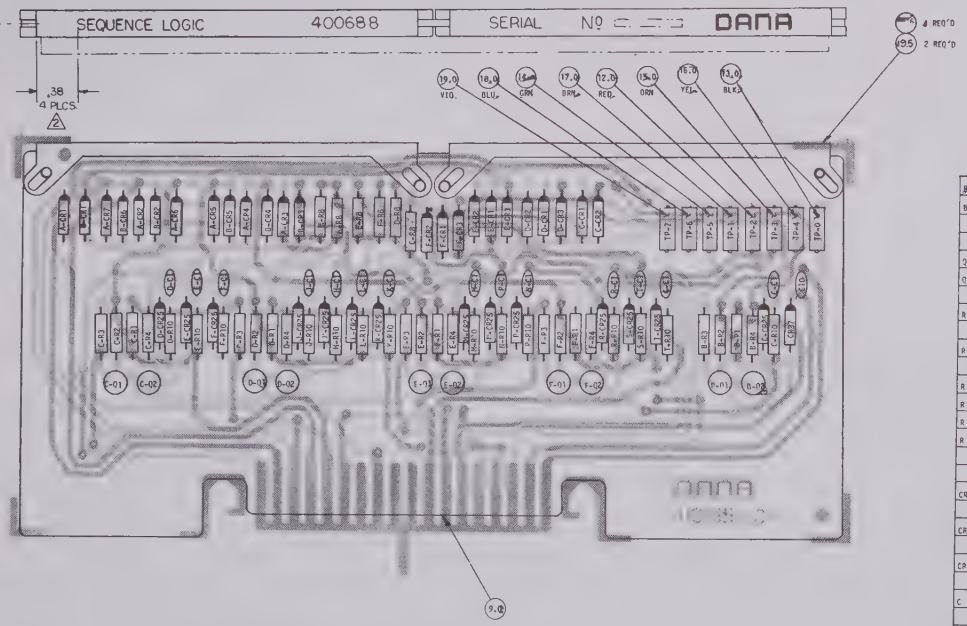
REL 6-10-66
DENIED

DANA LABORATORIES INC.
IRVINE, CALIFORNIA

SCHEMATIC — NULL DETECTOR, 4 DIGIT

SIZE	CODE IDENT NO.	DWG NO.	
D		430351	A

SCALE — WT — SHEET 1 OF 1



REF DES	B/M ITEM	DESCRIPTION
B-R3	4.0	8.2 K
B-R1	6.0	8.2 K
Q 2	8.0	2N3646
Q 1	8.0	2N3646
R 10	5.0	27 K
R 8	0.7	12 K
R 4	1.0	15 K
R 3	3.0	2.2 K
R 2	1.0	15 K
R 1	3.0	2.2K
CR 25	8.5	1N662
CR 7	8.5	1N662
CR 1	8.5	1N662
C 10	7.5	220 PF
C 1	7.0	33 PF

CROSS REFERENCE CHART	
ITEM NO	PART NO
9.0	610155 C1
12.0	600143
13.0	600144
14.0	600145
15.0	600146
16.0	600147
17.0	600148
18.0	600149
19.0	600150
12.5	610236
12.6	610237

QTY REQD	SYM	ITEM NO.	GOV'T OR VENDOR NO.	DANA PART NUMBER	NOMENCLATURE OR DESCRIPTION	CODE IDENT	SPECIFICATION

LIST OF MATERIAL OR PARTS LIST

MATERIAL

APPLIED FINISH

HEAT TREATMENT

UNLESS OTHERWISE SPECIFIED
DIMENSIONS ARE IN INCHES
TOLERANCES ON DECIMALS: X ± .030, XX ± .010, XXX ± .010; ANGLES ± 0° 30'
FORMED ANGLES ± 1.0°
ECCENTRICITY BETWEEN DIA ON THE SAME AXIS SHALL NOT EXCEED .010 TIR.
INTERPRET DRAWING IN ACCORDANCE WITH STANDARDS MIL-D-1000 AND MIL-D-70327

CONTRACT NO.

	NAME	DATE
DR	[illegible]	11-6-65
CHK	WMCgroy	11-19-65
APPD	[illegible]	

11-19-65

DANA LABORATORIES INC.
IRVINE, CALIFORNIA

PC BOARD ASS'Y
SEQUENCE LOGIC

SIZE	CODE IDENT NO.	DWG NO.	
D		400688	E

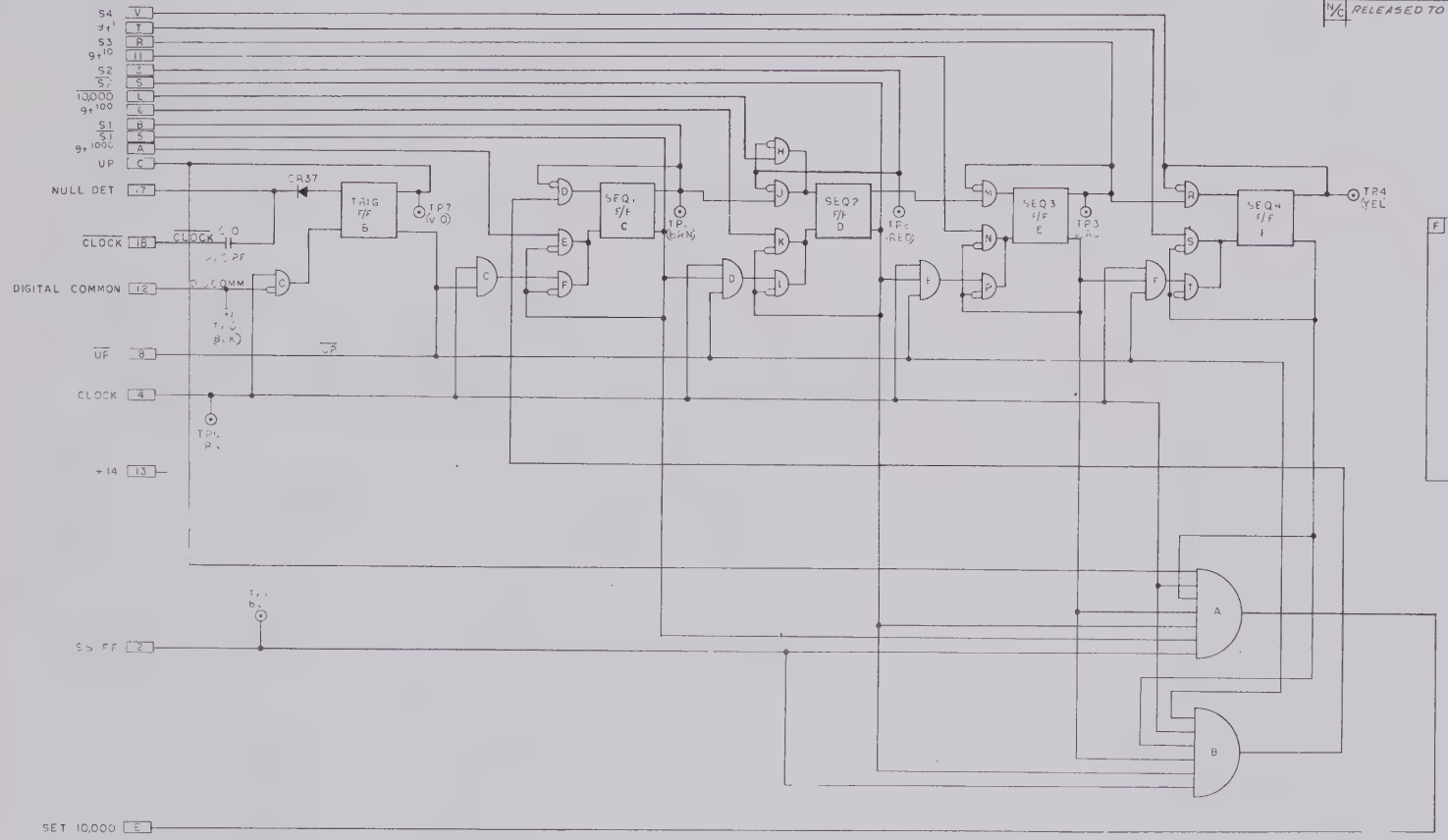
SCALE 2:1 | WT | SHEET 1 OF 1

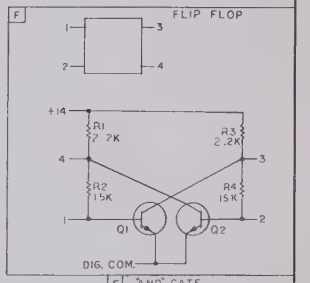
3. ASSEMBLY PROCEDURES AND PROCESSES TO CONFORM WITH DANA WORKMANSHIP STANDARDS.

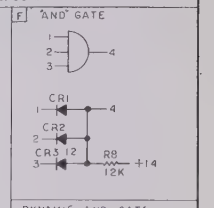
2. Heat stamp .10 high black characters and .15 high logo, located as shown.

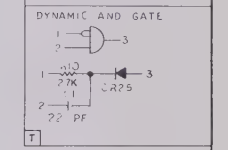
1. All resistors 1/4W, 5% carbon

NOTES: UNLESS OTHERWISE SPECIFIED









REVISIONS			
LTR	DESCRIPTION	DATE	APPROVED
N/C	RELEASED TO PRODUCTION PILOT	12 FEB 69	

NOTES: UNLESS OTHERWISE SPECIFIED

a. Resistors ± 5% ... are 0.25 W ± 2% ... Ω, ±ppm/°C.

b. Highest lettered reference designators for logic elements is shown in upper left hand corner of logic schematics.

c. Highest numbered reference designators:
30
T 10

d. All voltages referenced to ...

e. All transistors ...

f. All resistors 1/4W, 5%, Carbon

g. All diodes 1N662

QTY REQD	SYM	ITEM NO.	GOVT OR VENDOR NO.	DANA PART NUMBER	NOMENCLATURE OR DESCRIPTION	CODE IDENT	SPECIFICATION

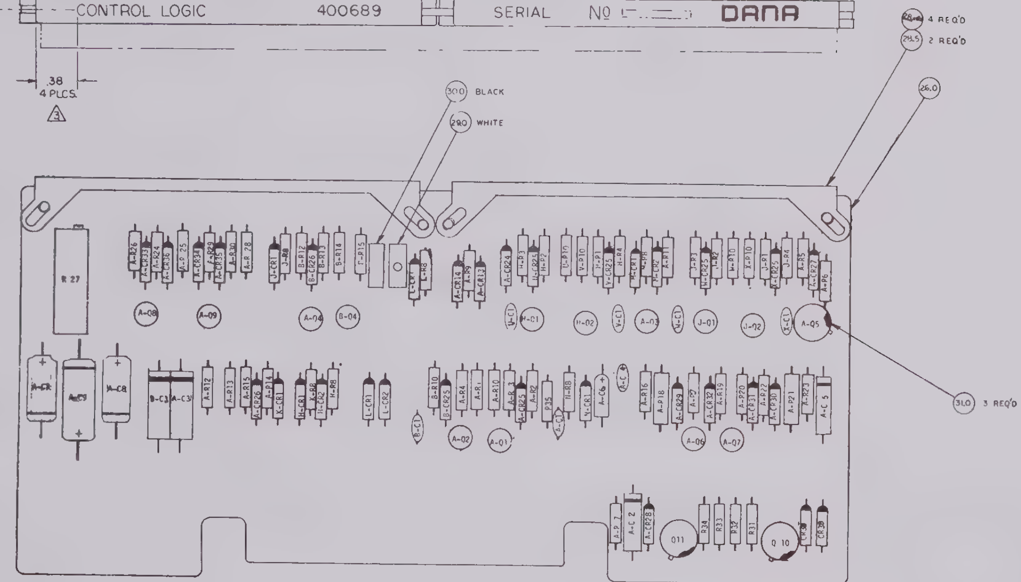
LIST OF MATERIAL OR PARTS LIST

MATERIAL	UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES TOLERANCES ON DECIMALS: X ± .030, XX ± .020, XXX ± .010 ANGLES: ± 0° 30' FORMED ANGLES ± 1.0° ECCENTRICITY BETWEEN DIA ON THE SAME AXIS SHALL NOT EXCEED .010 TIR. INTERPRET DRAWING IN ACCORDANCE WITH STANDARDS MIL-D-1000 AND MIL-D-70327	CONTRACT NO.	DANA LABORATORIES INC. IRVINE, CALIFORNIA
APPLIED FINISH		NAME / DATE DR A CHK APPD	SCHEMATIC — SEQUENCE LOGIC, MODEL 5400 DVM
HEAT TREATMENT			SIZE D — CODE IDENT NO. — DWG NO. 430348 SCALE — WT — SHEET 1 OF 1

96

CONTROL LOGIC 400689 SERIAL NO DANA

.38 4 PLCS. 3



R 1	8.0	2.8K
Q 11	23.0	014
Q 10	23.0	014
Q 9	24.0	2N3646
Thru		
Q 6	24.0	2N3646
Q 5	22.0	009
Q 4	24.0	2N3646
Thru		
Q 1	24.0	2N3646
CR36	25.0	018
Thru		
CR 1	25.0	018
C 9	19.0	25 MFD 25 V
C 8	18.0	5.0 MFD 50 V
C 7	18.0	5.0 MFD 50 V
C 6	17.0	1 MFD 35 V
C 5	19.5	.0033 MFD 100 V
C 4	16.5	[illegible] MFD DISC
C 3	21.3	.015 MFD 100V
C 2	21.5	.0015 MFD 100 V
C 1	15.0	33 PF
REF DES	B/M ITEM	DESCRIPTION

R 35	13.0	8.2 K
R 34	1.0	10 K
Thru		
R 31	1.0	10 K
R 30	11.0	27K
R 29	2.0	100 K
R 28	8.0	2.2 K
R 27	14.5	20 K (POT)
R 26	[illegible]	22K
R 25	8.0	2.2 K
R 24	2.0	100 K
R 23	5.0	15 K
R 22	2.0	100 K
R 21	14.0	1.2 K 1/2W 5%
R 20	7.0	20 K
R 19	7.0	20 K
R 18	14.0	1.2 K 1/2W 5%
R 17	2.0	100 K
R 16	5.0	15 K
R 15	2.0	100 K
R 14	13.0	8.2 K
R 13	5.0	15 K
R 12	10.0	24 K
R 11	6.0	200 ohms
R 10	11.0	27 K
R 9	7.5	200 K
R 8	13.0	12 K
R 7	9.0	2.4 K
R 6	5.0	15 K
R 5	12.0	6.[illegible] K
R 4	5.0	15 K
R 3	4.0	2.2K
R 2	5.0	15 K
REF DES	B/M ITEM	DESCRIPTION

CROSS REFERENCE CHART	
ITEM NO	PART NO
26.0	410158 F
28.5	610236
28.6	610237
29.0	600142
30.0	600144
31.0	920006

NOTES: UNLESS OTHERWISE SPECIFIED

1. ALL RESISTORS ARE 1/4 W, ± 5%, CARBON.
2. ASSEMBLY PROCEDURES AND PROCESSES TO CONFORM WITH DANA WORKMANSHIP STANDARDS.
3. (triangle) HEAT STAMP .10 HIGH BLACK CHARACTERS AND .15 HIGH LOGO, LOCATED AS SHOWN.

QTY REQD	SYM	ITEM NO.	GOV'T OR VENDOR NO.	DANA PART NUMBER	NOMENCLATURE OR DESCRIPTION	CODE IDENT	SPECIFICATION

LIST OF MATERIAL OR PARTS LIST

MATERIAL

APPLIED FINISH

HEAT TREATMENT

UNLESS OTHERWISE SPECIFIED
DIMENSIONS ARE IN INCHES
TOLERANCES ON
DECIMALS: .X ± .030, .XX ± .020, .XXX ± .010 | ANGLES ± 0° 30'
FORMED ANGLES ± 1.0°
ECCENTRICITY BETWEEN DIA ON THE SAME AXIS SHALL NOT EXCEED .010 TIR.
INTERPRET DRAWING IN ACCORDANCE WITH STANDARDS MIL-D-1000 AND MIL D-70327

CONTRACT NO.

	NAME	DATE
DR	W. Eoie	6 Nov. 1965
CHK	W McCurdy	12 Nov 65
APPD	Joe Burns	11/16/65

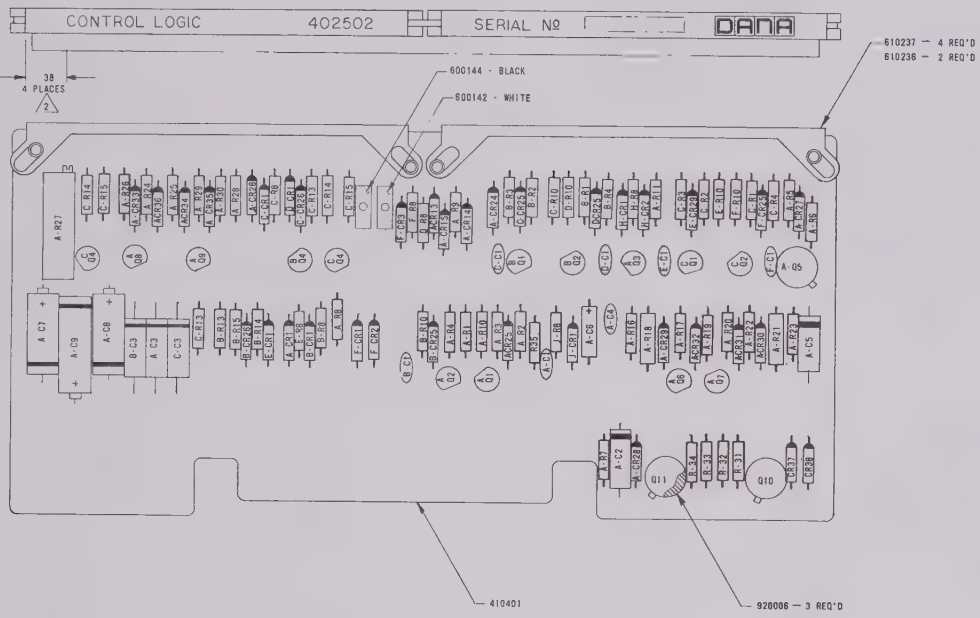
R.O. 11-17-65
DRN# 191

DANA LABORATORIES INC.
IRVINE, CALIFORNIA

P.C. BOARD ASSY- CONTROL LOGIC

SIZE	CODE IDENT NO.	DWG NO.	
D	—	400689	J

SCALE 2/1 | WT — | SHEET 1 OF 1



R2	000153	15k	R35	000822	8.2k
R1	000222	2.2k	R34	000103	10k
			R33	↑	↓
			R32	↑	↓
Q11	200035	014	R31	000103	10k
Q10	200035	014	R30	000273	27k
Q9	200037	2N3646	R29	000104	100k
↑	↑	↑	R28	000222	2 2k
↓	↓	↓	R27	040003	20k POT
Q8	200037	2N3646	R26	000223	22k
Q5	200011	009	R25	000222	2 2k
Q4	200037	2N3646	R24	000104	100k
↑	↑	↑	R23	000153	15k
THRU			R22	000104	100k
↓	↓	↓	R21	001469	1 2k,1/2W, 5Σ
Q1	200037	2N3646	R20	000205	20k
			R19	000203	20k
			R18	001469	1.2k 1/2W 5%
CR38	211083	018	R17	000104	100k
↑	↑	↑	R16	000153	15k
THRU			R15	000104	100k
↓	↓	↓	R14	000822	8.2k
CR1	211083	018	R13	000153	15k
			R11	000201	200 Ω
C9	110043	25UF/25V	R10	000273	27k
C8	110039	5UF/50V	R9	000204	200k
C7	110039	5UF/50V	R-R8	000432	4.3k
C6	110017	1UF/35V	R6	000123	12k
C5	120001	0033UF/100V	R7	000242	2.4k
C4	101174	001UF DISC	R6	000153	15k
C3	121090	015UF/100V	R5	000822	8 2k
C2	121473	0015UF/100V	R4	000153	15k
C1	100012	33pF DISC	R3	000222	2.2k
REF DES	PART NO	DESCRIPTION	REF DES	PART NO	DESCRIPTION

QTY REQD	DANA PART NUMBER	NOMENCLATURE OR DESCRIPTION	CODE IDENT	SPECIFICATION OR VENDOR P/N	ITEM NO.
		LIST OF MATERIAL OR PARTS LIST			

410401	5400	REF	REF
NEXT ASSY	USED ON	NA	FA
APPLICATION		QTY REQD	

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES
TOLERANCES ON: DECIMALS X .030, XX .020, XXX .010; ANGLES 0° 30'; FORMED ANGLES 1.0

CONTRACT NO.

MATERIAL

FINISH

DRAWN R T WOOD 17 AUG 1967

CHECK

DESIGN

PROJ ENGR EVO

DANA LABORATORIES INC.
IRVINE, CALIFORNIA

PC BOARD ASS'Y - CONTROL LOGIC

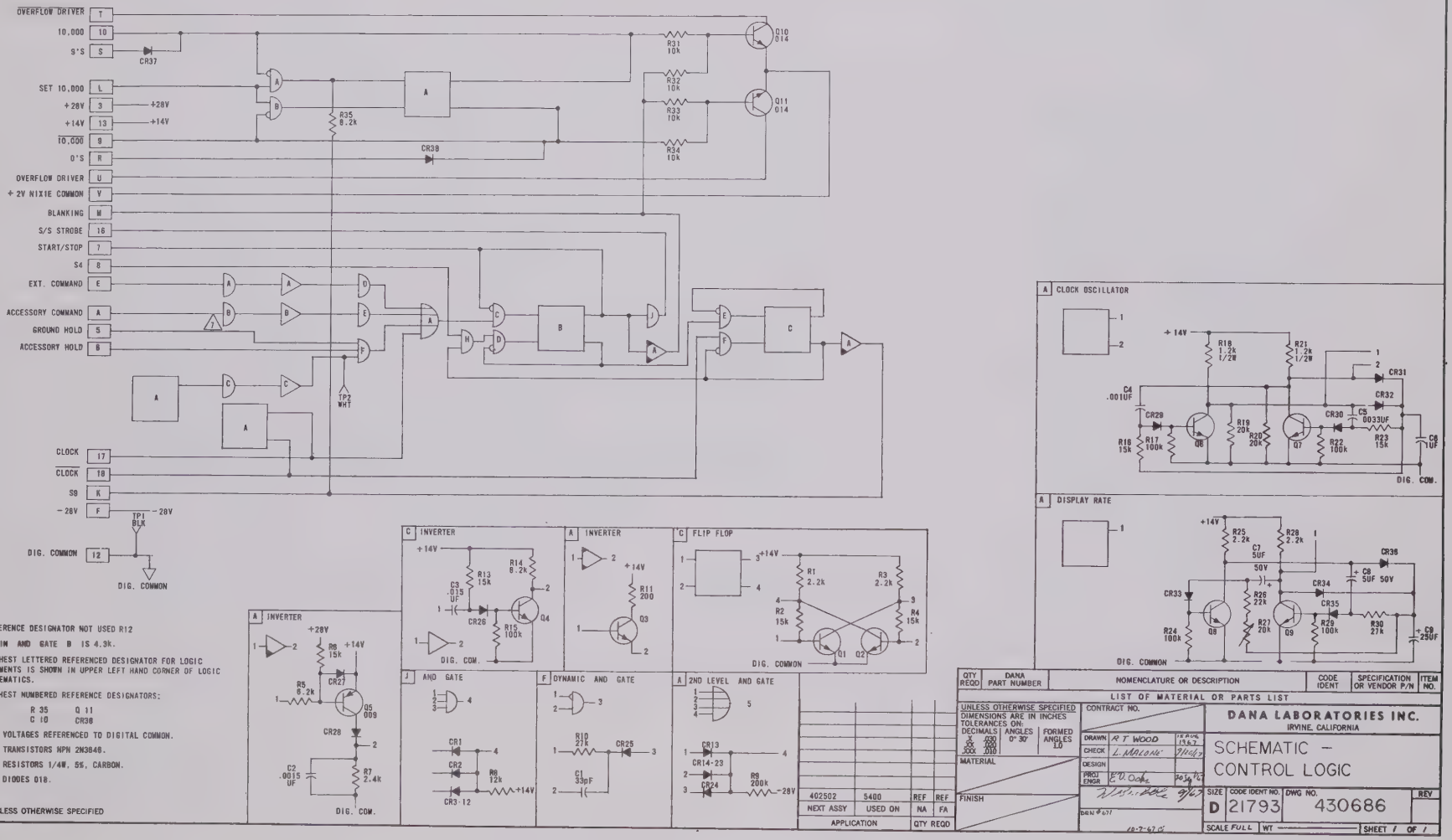
SIZE	CODE IDENT NO.	DWG NO.	REV
D	21793	402502	

SCALE 2:1 WT SHEET 1 OF 1

2. HEAT STAMP .10 HIGH BLACK CHARACTERS AND .15 HIGH LOGO, LOCATED AS SHOWN

1. ASSEMBLY PROCEDURE AND PROCESSES TO CONFORM WITH DANA WORKMANSHIP STANDARDS

NOTE: UNLESS OTHERWISE SPECIFIED



8. REFERENCE DESIGNATOR NOT USED R12
7. R8 IN AND GATE B IS 4.3k.
6. HIGHEST LETTERED REFERENCED DESIGNATOR FOR LOGIC ELEMENTS IS SHOWN IN UPPER LEFT HAND CORNER OF LOGIC SCHEMATICS.
5. HIGHEST NUMBERED REFERENCE DESIGNATORS:
   R 35 Q 11
   C 10 CR38
4. ALL VOLTAGES REFERENCED TO DIGITAL COMMON.
3. ALL TRANSISTORS NPN 2N3646.
2. ALL RESISTORS 1/4W, 5%, CARBON.
1. ALL DIODES 018.

NOTE: UNLESS OTHERWISE SPECIFIED

QTY REQD	DANA PART NUMBER	NOMENCLATURE OR DESCRIPTION	CODE IDENT	SPECIFICATION OR VENDOR P/N	ITEM NO.

LIST OF MATERIAL OR PARTS LIST

402502	5400	REF	REF
NEXT ASSY	USED ON	NA	FA
APPLICATION		QTY REQD	

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES
TOLERANCES ON: DECIMALS .XX ±.030 .XXX ±.010; ANGLES 0° 30'; FORMED ANGLES ±0
MATERIAL
FINISH

CONTRACT NO.

DRAWN	R T WOOD	10-6-67
CHECK	L. MALONE	10/6/67
DESIGN		
PROJ ENGR	E.D. Oaks	10/6/67
		10/6/67

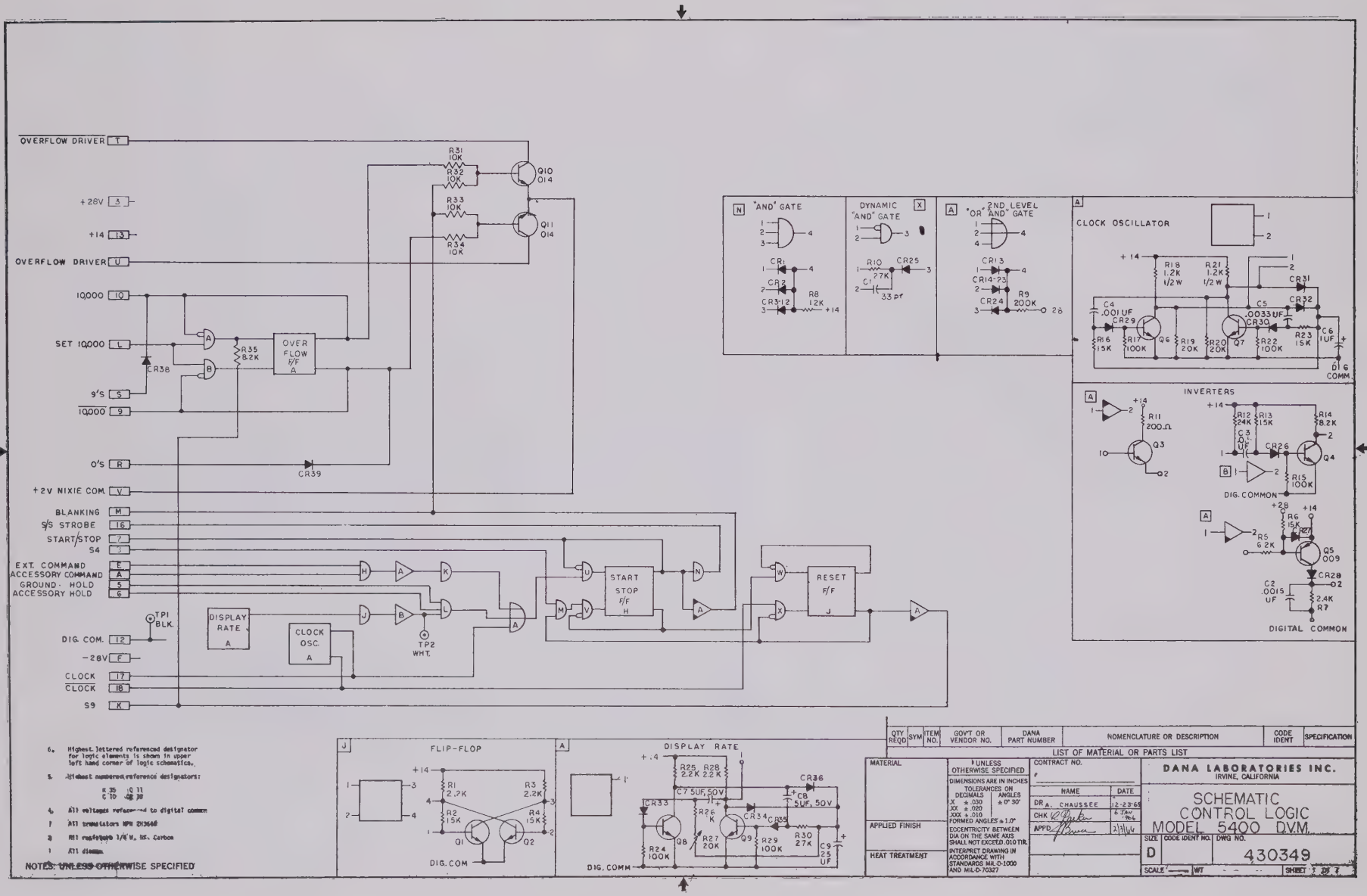
DRN # 671

DANA LABORATORIES INC.
IRVINE, CALIFORNIA

SCHEMATIC — CONTROL LOGIC

SIZE	CODE IDENT NO.	DWG NO.	REV
D	21793	430686	

SCALE FULL WT — SHEET 1 OF 1



NOTES: UNLESS OTHERWISE SPECIFIED

6. Highest lettered reference designator for logic elements is shown in upper left hand corner of logic schematics.
5. Highest numbered reference designators:
   R 35 C 10 CR 39 Q 11
4. All voltages referenced to digital common
1. All transistors NPN 2N3646
2. All resistors 1/4 W, 5% Carbon
1. All diodes

QTY REQD	SYM	ITEM NO.	GOV'T OR VENDOR NO.	DANA PART NUMBER	NOMENCLATURE OR DESCRIPTION	CODE IDENT	SPECIFICATION

LIST OF MATERIAL OR PARTS LIST

MATERIAL	
APPLIED FINISH	
HEAT TREATMENT	

UNLESS OTHERWISE SPECIFIED
DIMENSIONS ARE IN INCHES
TOLERANCES ON DECIMALS: X ± .030, XX ± .020, XXX ± .010; ANGLES ± 0° 30'
FORMED ANGLES ± 1.0°
ECCENTRICITY BETWEEN DIA ON THE SAME AXIS SHALL NOT EXCEED .010 TIR.
INTERPRET DRAWING IN ACCORDANCE WITH STANDARDS MIL-D-1000 AND MIL-D-70327

CONTRACT NO.

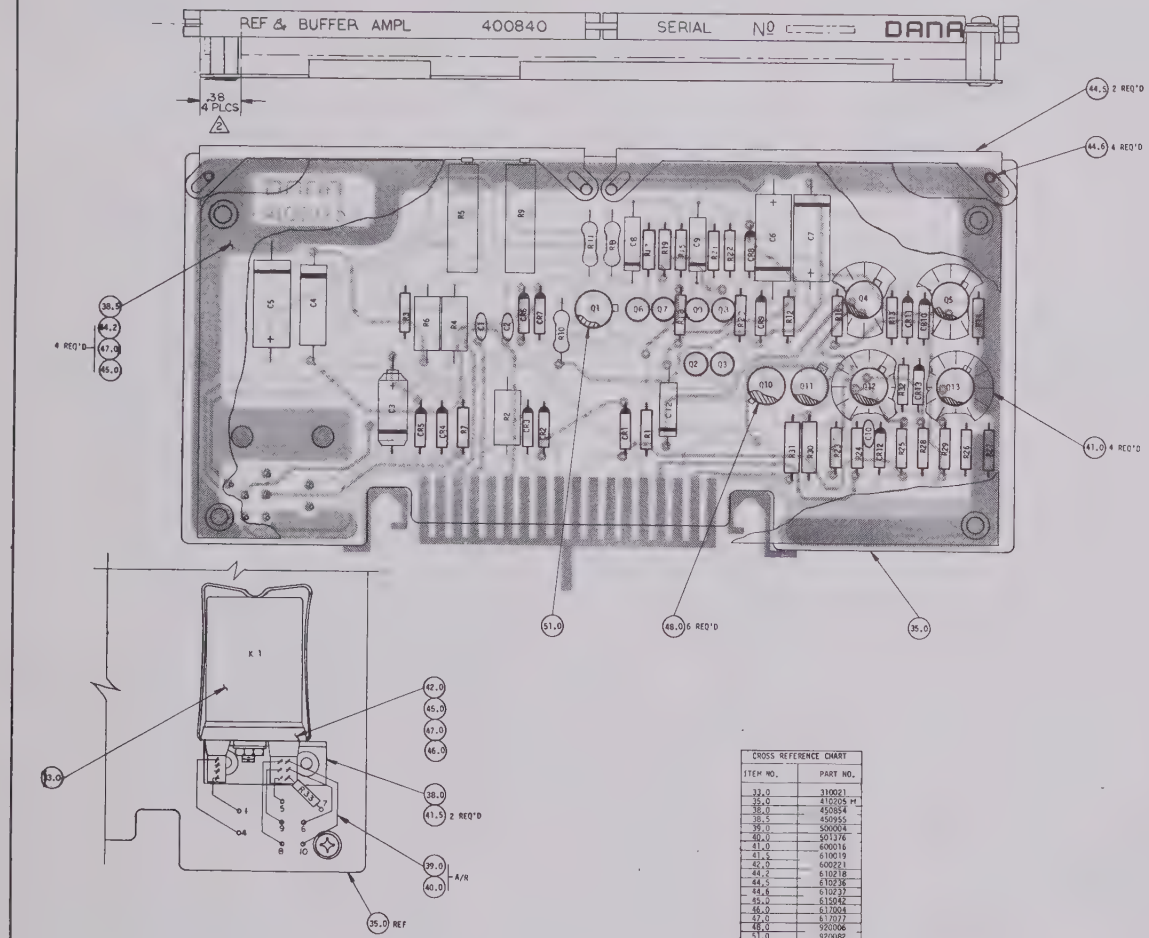
	NAME	DATE
DR	A. CHAUSSEE	12-23-69
CHK		6 Jan 1970
APPD		2/3/70

DANA LABORATORIES INC.
IRVINE, CALIFORNIA

SCHEMATIC
CONTROL LOGIC
MODEL 5400 DVM

SIZE	CODE IDENT NO.	DWG NO.
D		430349

SCALE — WT — SHEET 1 OF 1



R8	14.0	200 K, 1%
R7	12.3	680 ohms
R6	34.0	FSV, 6.10-6.38 K, .1%
R5	16.0	POT - 5 K, E-Z TRIM
R4	34.0	FSV, 3.55-3.83 K, .1%
R3	8.5	30 ohms
R2	34.0	FSV, 200-1000 ohm, 1%
R1	11.0	5.1 K
CR13	30.7	IN961
CR12	30.0	018
CR11	30.0	018
CR10	30.0	018
CR9	32.0	1N958B
CR8	32.0	1N958B
CR7	30.5	007
CR6	30.5	007
CR5	30.0	018
CR4	30.0	018
CR3	34.0	FSV, BRIDGE ELEMENT
CR2	30.5	007
CR1	31.0	1N751
C12	23.9	.0022UF, 100V
C10	20.0	100 pf, DISC
C9	23.0	.001 uf, 100V
C8	23.0	.001 uf, 100V
C7	21.0	25 uf, 50V
C6	21.0	25 uf, 50V
C5	21.0	25 uf, 50V
C4	24.0	.047 uf 100V
C3	22.0	1 uf, 50V
C2	19.5	150 pf, DISC
C1	18.9	330 pf, DISC
REF DES	B/M ITEM	DESCRIPTION

Q 13	25.0	009
Q 12	26.0	014
Q 11	26.0	014
Q 10	25.0	009
Q 9	28.0	2N3565
Q 8	28.0	2N3565
Q 7	28.0	2N3565
Q 5	26.0	014
Q 4	25.0	009
Q 3	28.0	2N3565
Q 2	28.0	2N3565
Q 1	27.0	016
R33	12.3	680 Ω
R32	2.0	1 K
R31	13.5	1.6 K, 1/2 W
R30	13.5	1.6 K, 1/2 W
R29	6.0	24 ohms
R28	6.0	24 ohms
R27	12.4	6.8 K
R26	9.5	470 Ω
R25	2.0	1 K
R24	10.0	47 K
R23	2.0	1 K
R22	7.0	2.4 K
R21	3.0	1 MEG
R20	11.5	6.2 K
R19	9.0	36 K
R18	11.5	6.2 K
R17	3.0	1 MEG
R16	1.0	100 ohms
R15	7.0	2.4 K
R14	8.0	27 K
R13	1.0	100 ohms
R12	4.0	1.2 K
R11	14.0	200 K, 1%
R10	15.0	182 K, 1%
R9	17.0	POT - 50 K, E-Z TRIM
REF DES	B/M ITEM	DESCRIPTION

CROSS REFERENCE CHART	
ITEM NO.	PART NO.
33.0	310021
35.0	410205 M
38.0	450854
38.5	450955
39.0	500004
40.0	501376
41.0	600016
41.5	610019
42.0	600221
44.2	610218
44.5	610236
44.6	610237
45.0	615042
46.0	617004
47.0	617077
48.0	920006
51.0	920082

QTY REQD	SYM	ITEM NO.	GOVT OR VENDOR NO.	DANA PART NUMBER	NOMENCLATURE OR DESCRIPTION	CODE IDENT	SPECIFICATION

LIST OF MATERIAL OR PARTS LIST

MATERIAL

APPLIED FINISH

HEAT TREATMENT

UNLESS OTHERWISE SPECIFIED
DIMENSIONS ARE IN INCHES
TOLERANCES ON DECIMALS: X ± .030, XX ± .020, XXX ± .010; ANGLES ± 0° 30'
FORMED ANGLES ± 1.0°
ECCENTRICITY BETWEEN DIA ON THE SAME AXIS SHALL NOT EXCEED .010 TIR.
INTERPRET DRAWING IN ACCORDANCE WITH STANDARDS MIL-D-1000 AND MIL-D 70327

CONTRACT NO.

NAME	DATE
DR	8/3/66 1766
CHK	10 SEP 1966
APPD	9/10/66

Rel 6-10-65
P.R. No. 4218

DANA LABORATORIES INC.
IRVINE, CALIFORNIA

PC BOARD ASSY - REFERENCE & BUFFER AMPLIFIER

SIZE	CODE IDENT NO.	DWG NO.	
D	—	400840	K

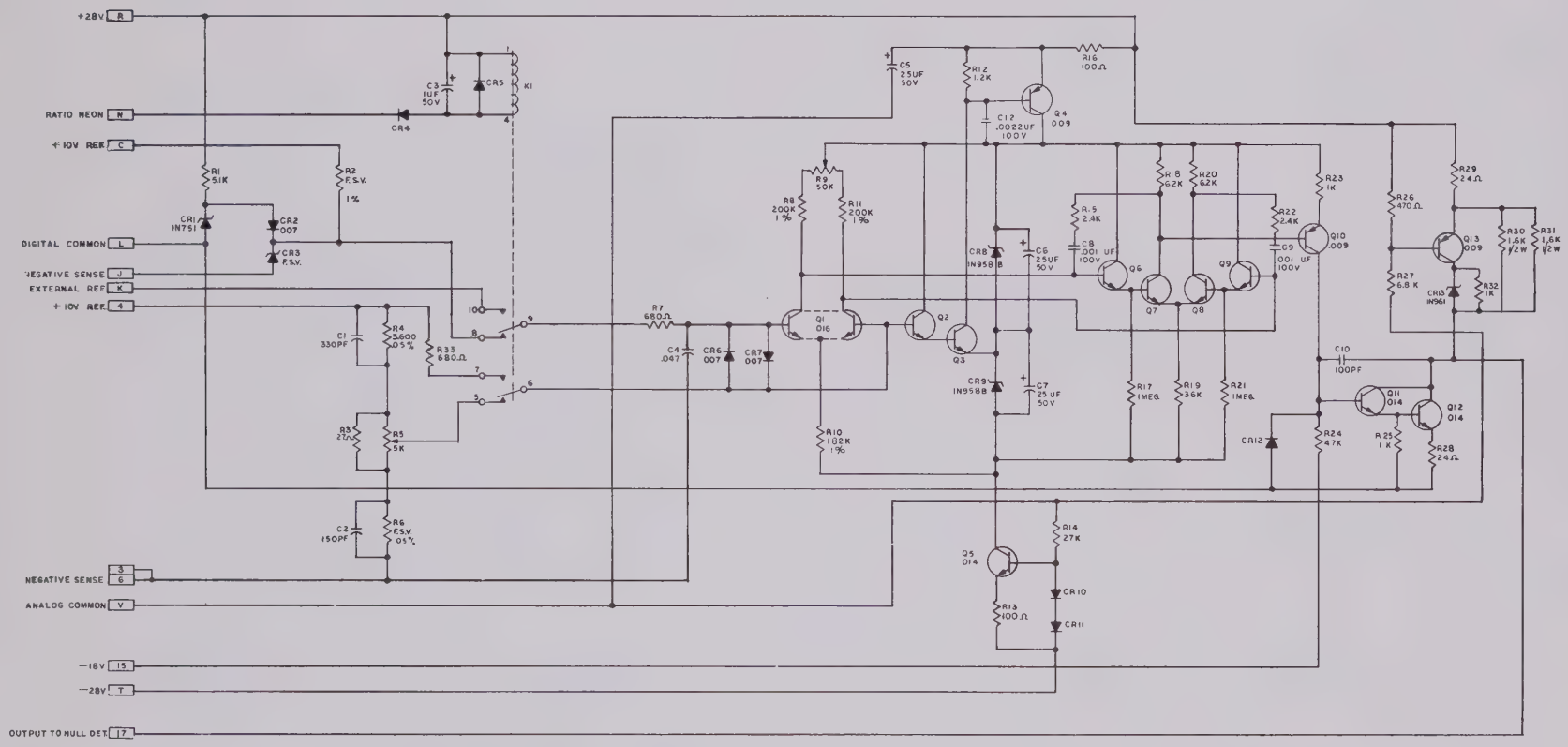
SCALE 2/1 WT — SHEET 1 OF 1

3. ASSEMBLY PROCEDURES AND PROCESSES TO CONFORM WITH DANA WORKMANSHIP STANDARDS.

2 Heat stamp .10 high black characters and .15 high Logo, located as shown.

1. All resistors 1/4 W, 5%, carbon.

NOTES: UNLESS OTHERWISE SPECIFIED



5. Relay shown in de-energized position
4. Highest numbered reference designators
   R23 Q13
   C15 CR18
3. All transistors, 2N3565
2. All resistors, 1/4W, 5%, Carbon
1. All diodes D18

NOTES: UNLESS OTHERWISE SPECIFIED

QTY REQD	SYM	ITEM NO.	GOV'T OR VENDOR NO.	DANA PART NUMBER	NOMENCLATURE OR DESCRIPTION	CODE IDENT	SPECIFICATION

LIST OF MATERIAL OR PARTS LIST

MATERIAL

APPLIED FINISH

HEAT TREATMENT

UNLESS OTHERWISE SPECIFIED
DIMENSIONS ARE IN INCHES
TOLERANCES ON DECIMALS: X ±.030, .XX ±.000, .XXX ±.010
ANGLES ±0° 30'
FORMED ANGLES ±1.0°
ECCENTRICITY BETWEEN DIA ON THE SAME AXIS SHALL NOT EXCEED .010 TIR.
INTERPRET DRAWING IN ACCORDANCE WITH STANDARDS MIL-D-1000 AND MIL-D-70327

CONTRACT NO.

	NAME	DATE
DR	A. CHAUSSEE	1-10-66
CHK	M. Curtis	Jan 66
APPD	J. Nelson	1-13-66

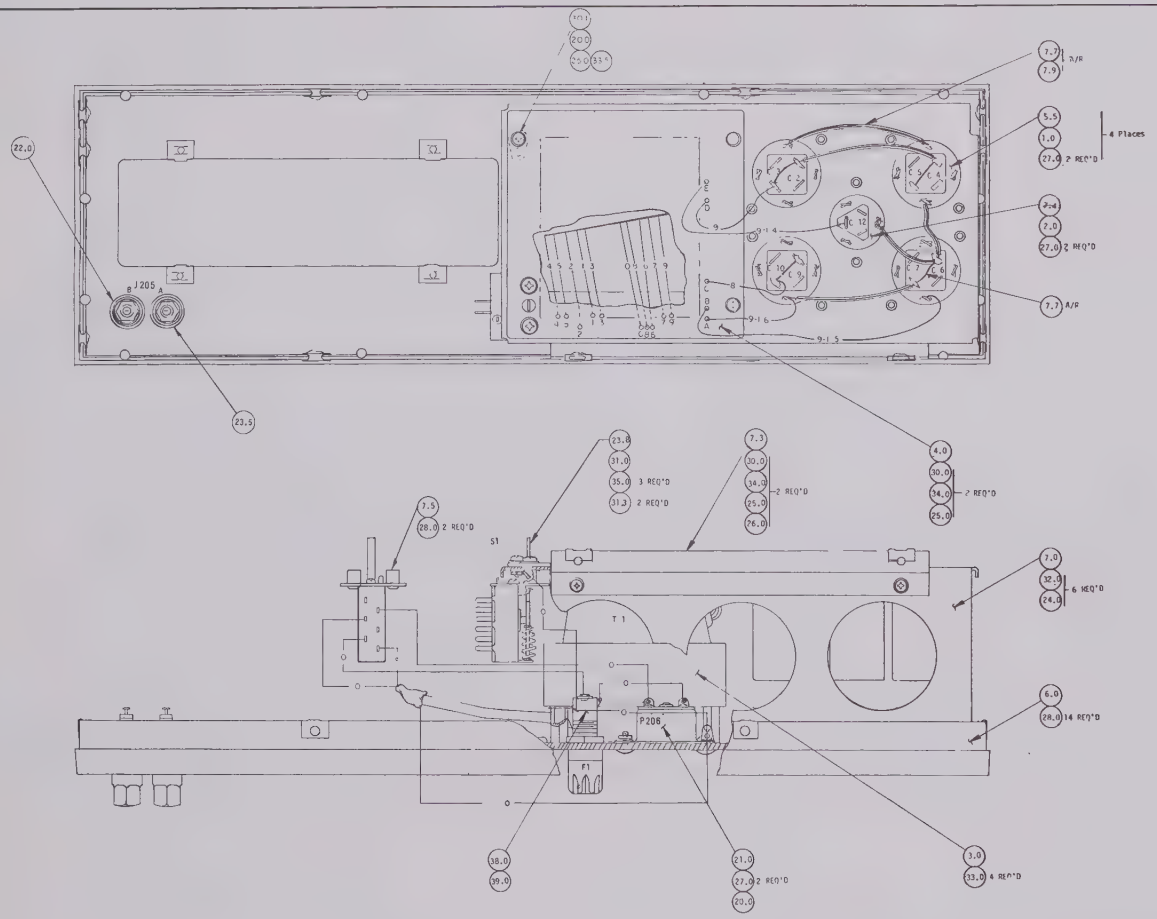
Rel 6-10-66
DRN 4218 BR

DANA LABORATORIES INC.
IRVINE, CALIFORNIA

SCHEMATIC REFERENCE & BUFFER AMPLIFIER

SIZE	CODE IDENT NO.	DWG NO.	
D		430350	F

SCALE — WT — SHEET 1 OF 1



CROSS REFERENCE CHART	
ITEM NO.	PART NO.
3.0	300009
4.0	400707
5.5	450188
6.0	450810
7.0	450821
7.3	450888
7.4	450918
7.5	452274
7.8	500002
7.7	500004
7.9	501376
8.0	501446
8.5	524000
13.0	524914
14.0	524915
15.0	524916
18.3	524888
18.6	524899
18.9	600028
20.0	600032
21.0	600126
22.0	600230
23.5	600244
23.7	600257
23.8	600310
24.0	610101
25.0	610111
26.0	610130
27.0	610138
28.0	610195
30.0	615042
30.1	615043
31.0	615056
31.3	615059
32.0	615557
33.0	615573
33.5	617004
34.0	617077
35.0	617079
38.0	920099
39.0	921539

REF. DES.	B/M ITEM	DESCRIPTION
C 12	2.0	50 MFD 350V
C 10		
C 9	1.0	1000 MFD 35V (DUAL)
C 7		
C 6	1.0	1000 MFD 35V (DUAL)
C 5		
C 4	1.0	1000 MFD 35V (DUAL)
C 3		
C 2	1.0	1000 MFD 35V (DUAL)

QTY REQD	SYM	ITEM NO.	GOVT OR VENDOR NO.	DANA PART NUMBER	NOMENCLATURE OR DESCRIPTION	CODE IDENT	SPECIFICATION

LIST OF MATERIAL OR PARTS LIST

MATERIAL: SEE L/M

APPLIED FINISH

HEAT TREATMENT

UNLESS OTHERWISE SPECIFIED
DIMENSIONS ARE IN INCHES
TOLERANCES ON
DECIMALS: .XX ± .030, .XXX ± .020, .XXXX ± .010
ANGLES: ± 0° 30'
FORMED ANGLES ± 1.0°
ECCENTRICITY BETWEEN DIA ON THE SAME AXIS SHALL NOT EXCEED .010 TIR.
INTERPRET DRAWING IN ACCORDANCE WITH STANDARDS MIL-D-1000 AND MIL-D 70327

CONTRACT NO.

	NAME	DATE
DR	[illegible]	1/11
CHK	[illegible]	1/20
APPD	[illegible]	1/26 PES
		1/26/66

DANA LABORATORIES INC.
IRVINE, CALIFORNIA

REAR PANEL ASSY - 5400

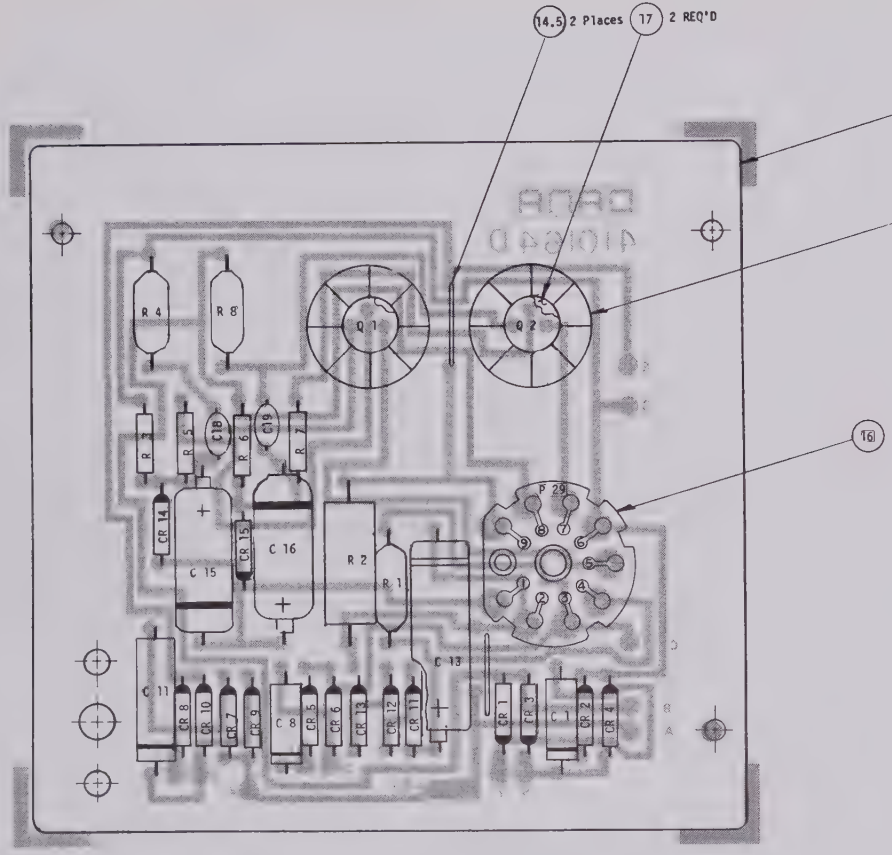
SIZE: D | CODE IDENT NO. | DWG NO. 400684 | S

SCALE 1/1 | WT | SHEET 1 OF 1

NOTES: UNLESS OTHERWISE SPECIFIED

1. ASSEMBLY PROCEDURES AND PROCESSES TO CONFORM WITH DANA WORKMANSHIP STANDARDS.

2. SCHEMATIC REFERENCE: 430 S.C



REF DES	B/M ITEM	DESCRIPTION
CR15	12.0	1N967B
CR14	12.0	1N967B
CR13	11.0	SD-4
↑ THRU ↓	↑ ↓	↑ ↓
CR 1	11.0	SD-4
C19	5.5	.001 UF
C 18	5.5	.001 UF
C 16	6.0	25 MFD, 50 V
C 15	6.0	25 MFD, 50 V
C 13	7.0	250 MFD, 6 V
C 11	8.0	.01 MFD, 600 V
C 8	8.5	.01 MFD, 100 V
C 1	8.5	.01 MFD, 100 V

REF DES	B/M ITEM	DESCRIPTION
R 8	3.0	150 ohm, 3 W
R 7	1.0	150 ohm
R 6	2.0	2 K
R 5	1.0	150 ohm
R 4	3.0	150 ohm, 3 W
R 3	2.0	2 K
R 2	5.0	220 K, 2 W
R 1	4.0	200 ohm, 3 W
Q 2	9.0	009
Q 1	10.0	014

CROSS REFERENCE CHART	
ITEM NO.	PART NUMBER
13.0	410164, D
14.5	500004
15.0	600016
16.0	600234
17.0	920006

QTY REQD	SYM	ITEM NO.	GOV'T IDENT NO.	DANA PART NUMBER	NOMENCLATURE OR DESCRIPTION	SPECIFICATION
LIST OF MATERIALS OR PARTS LIST						

400684	5400	1	1
NEXT ASSY	USED ON	NEXT ASSY	FINAL ASSY
APPLICATION		QTY REQD	

SYMBOLS
APPLICABLE TO DANA LABORATORIES INC. ONLY
SA.....SUB-ASSY MRA.....MAJOR REPL ASSY
MA.....MODULE ASSY CA.....COMPLETE ASSY

UNLESS OTHERWISE SPECIFIED
DIMENSIONS ARE IN INCHES
TOLERANCES ON
DECIMALS: .X ± .030, .XX ± .020, .XXX ± .010
ANGLES ± 0° 30'

MATERIAL

APPLIED FINISH

DRAWN	W. Edie	13 Oct. 1965
CHECK	Toft	13 OCT 1965
ENGR		
APPR	Joe Bruce	10/14/65

APPROVED

APPROVED

Per 11-17-65
DRN #200

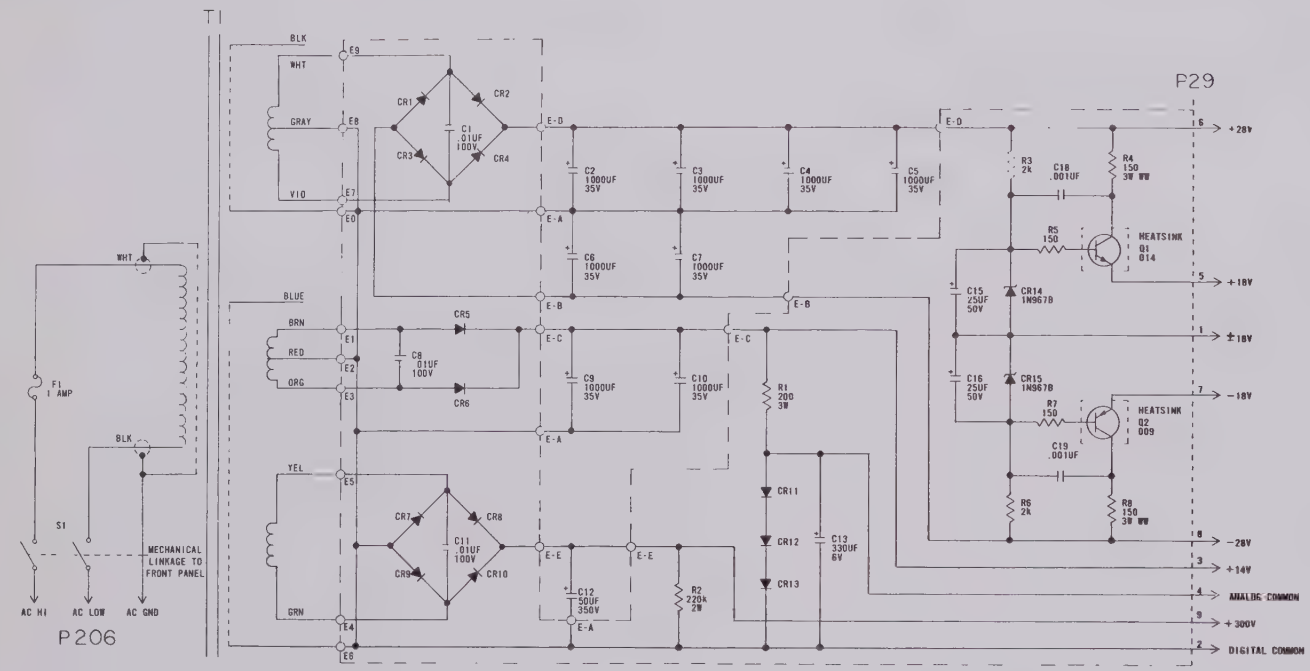
DANA LABORATORIES INC.
IRVINE, CALIFORNIA

P.C. BOARD ASS'Y- POWER SUPPLY

CODE IDENT NO.	SIZE		
	C	400707	K
SCALE 2/1	WEIGHT —	SHEET 1 OF 1	

NOTES: UNLESS OTHERWISE SPECIFIED

1. ALL RESISTORS ARE 1/4 W, ± 5%, CARBON.
2. ASSEMBLY PROCEDURES AND PROCESSES TO CONFORM WITH DANA WORKMANSHIP STANDARDS.
3. SCHEMATIC REFERENCE: 430318



3. HIGHEST REFERENCE DESIGNATORS ARE: C19, CR15, F1, Q2, R8, T1
2. ALL DIODES ARE SD 4'S.
1. ALL RESISTORS ARE 1/4W, 5%, CARBON.

NOTE: UNLESS OTHERWISE SPECIFIED

QTY REQD	DANA PART NUMBER	NOMENCLATURE OR DESCRIPTION	CODE IDENT	SPECIFICATION OR VENDOR P/N	ITEM NO.

LIST OF MATERIAL OR PARTS LIST

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES
TOLERANCES ON: DECIMALS X .030, XX .020, XXX .010; ANGLES 0° 30'; FORMED ANGLES 1.0
MATERIAL
FINISH
NEXT ASSY | USED ON | NA | FA
APPLICATION | QTY REQD

CONTRACT NO.

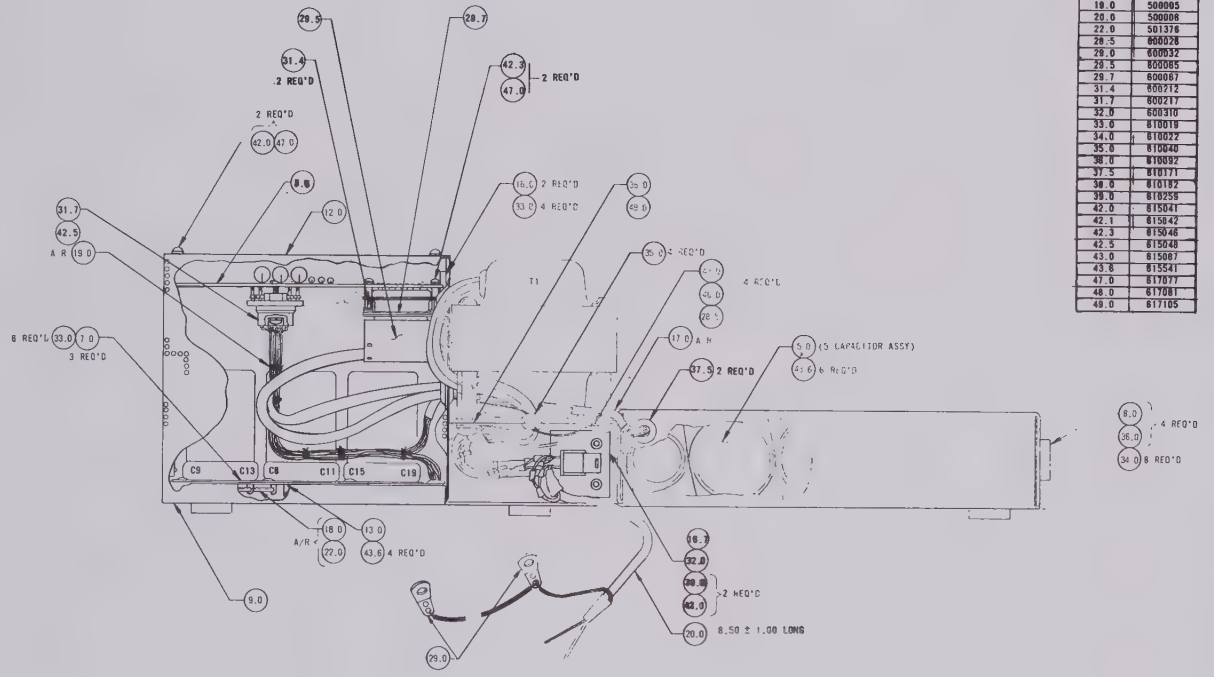
DRAWN P. HARRIS EE 9-17-65
CHECK J NELSON 9/27/65
COG. ENGR
PROJ ENGR
REL 12-10-65
DRN # 214 SAM

DANA LABORATORIES INC.
IRVINE, CALIFORNIA

SCHEMATIC - PWR SUP REAR PANEL

SIZE	CODE IDENT NO.	DWG NO.	REV
D	—	430318	E

SCALE — | WT — | SHEET 1 OF 1



CROSS REFERENCE CHART	
ITEM NO.	PART NO.
5.0	402019
5.5	402318
7.9	450188
8.0	450380
8.0	450890
12.0	450984
13.0	450985
16.0	452031
18.7	452379
17.0	500002
18.0	500004
19.0	500005
20.0	500006
22.0	501376
28.5	600028
29.0	600032
28.5	600065
29.7	600067
31.4	600212
31.7	600217
32.0	600310
33.0	610019
34.0	610022
35.0	610040
38.0	610092
37.5	610171
38.0	610182
39.0	610256
42.0	615041
42.1	615042
42.3	615046
42.5	615048
43.0	615087
43.6	615541
47.0	617077
48.0	617081
49.0	617105

REF DES	B/M ITEM	DESCRIPTION
T1	3.0	300017
C19		
C15	1.0	1000UF 35V (DUAL)
C11		
C8	1.0	1000UF 35V (DUAL)
C13		
C9	1.0	1000UF 35V (DUAL)

QTY REQD	DANA PART NUMBER	NOMENCLATURE OR DESCRIPTION	CODE IDENT	SPECIFICATION OR VENDOR P/N	ITEM NO.
402182	5403	1	1		
NEXT ASSY	USED ON	NA	FA		
APPLICATION		QTY REQD			

LIST OF MATERIAL OR PARTS LIST

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES
TOLERANCES ON: DECIMALS .X ±.030, .XX ±.010, .XXX ±.005; ANGLES 0° 30'; FORMED ANGLES 1.0

MATERIAL

FINISH

CONTRACT NO.

DANA LABORATORIES INC.
IRVINE, CALIFORNIA

DRAWN	M. BERG	7-24-67
CHECK	T. WRYE	7-24-67
COG ENGR	M. CURTIS	7-24-67
PROJ ENGR		8/7/67

DWNG 670

POWER SUPPLY ASSY-
5403 DVM

SIZE	CODE IDENT NO.	DWG NO.	REV
D	---	402000	B

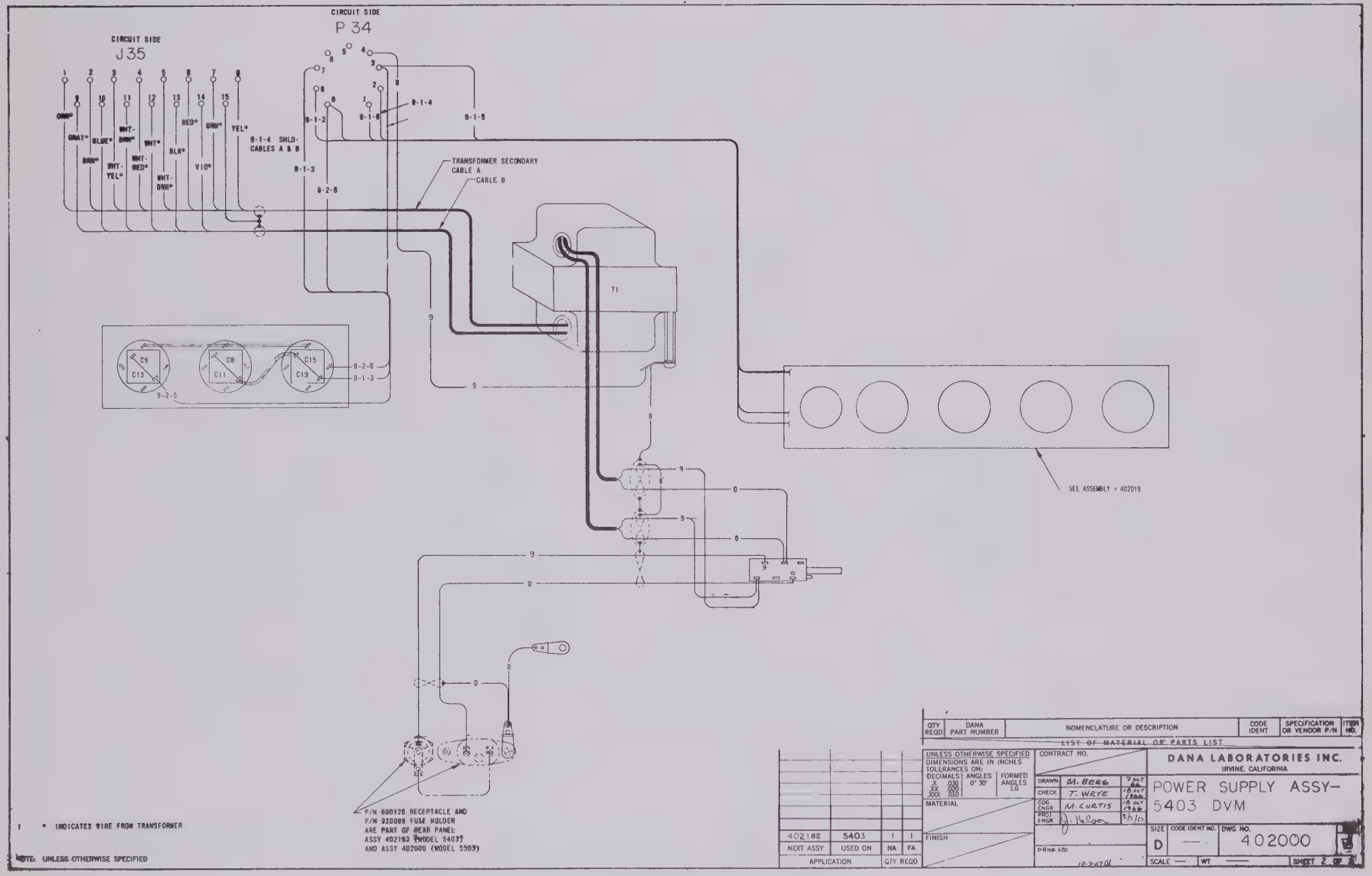
SCALE 1/1 | WT | SHEET 1 OF 2

ASSEMBLY PROCEDURES AND PROCESSES TO CONFORM TO DANA WORKMANSHIP STANDARDS.

SCHEMATIC 430571.

NOTE: UNLESS OTHERWISE SPECIFIED

31



QTY REQD	DANA PART NUMBER	NOMENCLATURE OR DESCRIPTION	CODE IDENT	SPECIFICATION OR VENDOR P/N	ITEM NO.
		LIST OF MATERIAL OR PARTS LIST			

402182	5403	1	1
NEXT ASSY	USED ON	NA	FA
APPLICATION		QTY REQD	

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES
TOLERANCES ON: DECIMALS X .030 .XXX .010; ANGLES 0° 30'; FORMED ANGLES 1.0
MATERIAL
FINISH
DRNE 670

CONTRACT NO.

DRAWN	M. BERG	7 OCT 66
CHECK	T. WEYE	10 OCT 1966
COG ENGR	M. CURTIS	10 OCT 1966
PROJ ENGR	[illegible]	6/7/67

DANA LABORATORIES INC.
IRVINE, CALIFORNIA

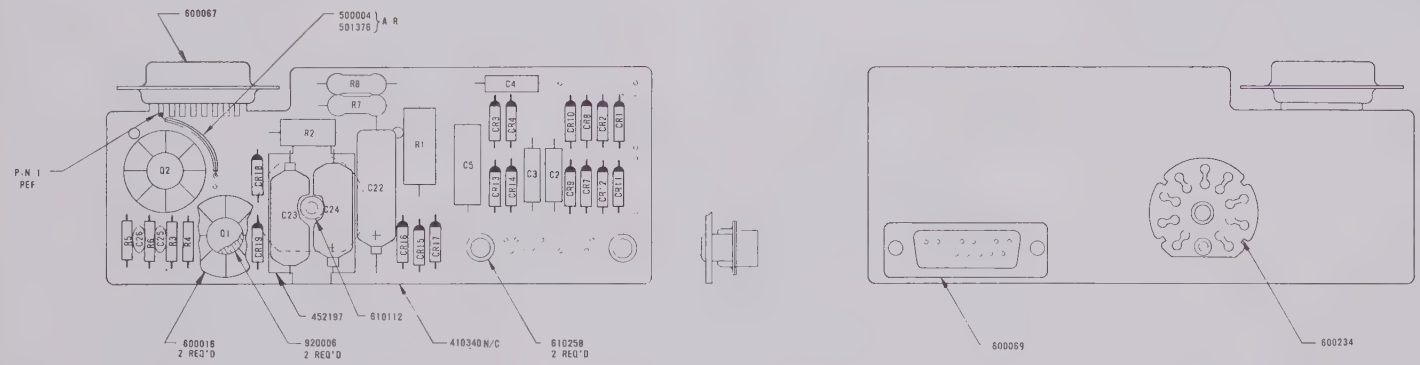
POWER SUPPLY ASSY-
5403 DVM

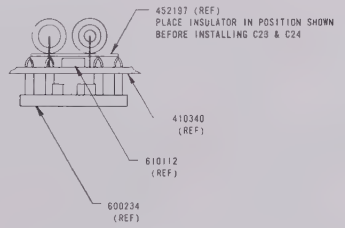
SIZE	CODE IDENT NO.	DWG NO.
D	—	402000

SCALE — WT — SHEET 2 OF 2

10-24-67

32





CR19	220015	1N967B
CR18	220015	1N967B
CR17	210004	SD-4
THRU	↕	↕
CR7		
CR4		
THRU	↕	↕
CR1	210004	SD-4
C26	101174	.001UF DISC
C25	101174	.001UF DISC
C24	110036	25UF/50V
C23	110036	25UF/50V
C22	110041	25UF/6V
C5	120072	.01UF/600V
C4	121088	.01UF/100V
C3	121088	.01UF/100V
C2	121088	.01UF/100V
REF DES	PART NO.	DESCRIPTION

R8	030007	150 OHMS/3W
R7	030007	150 OHMS/3W
R6	000151	150 OHMS
R5	000151	150 OHMS
R4	000202	2 K
R3	000202	2 K
R2	030008	200 OHMS/3W
R1	031450	220 K/2W
Q2	200011	009
Q1	200035	014
REF DES	PART NO.	DESCRIPTION

QTY REQD	DANA PART NUMBER	NOMENCLATURE OR DESCRIPTION	CODE IDENT	SPECIFICATION OR VENDOR P/N	ITEM NO.
LIST OF MATERIAL OR PARTS LIST					

UNLESS OTHERWISE SPECIFIED
DIMENSIONS ARE IN INCHES
TOLERANCES ON:
DECIMALS | ANGLES | FORMED ANGLES
X .030 | 0° 30' | 1.0
XX .020
XXX .010

MATERIAL

FINISH

CONTRACT NO.

DRAWN	[illegible] Berg	2 7 66
CHECK	[illegible]	1-27-67
COG ENGR	[illegible]	[illegible]
PROJ ENGR		

DANA LABORATORIES INC.
IRVINE, CALIFORNIA

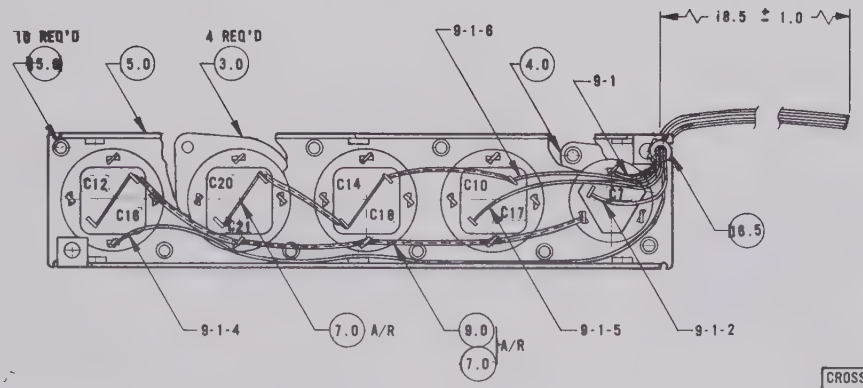
PC BOARD ASSY
POWER SUPPLY

SIZE	CODE IDENT NO.	DWG NO.	REV
D	[illegible]	402316	

SCALE 2/1 | WT | SHEET 1 OF 1

NEXT ASSY	USED ON	NA	FA
402000	5403	1	1
APPLICATION		QTY REQD	

3. SCHEMATIC REFERENCE: 430571
2 ASSEMBLY PROCEDURES AND PROCESSES TO CONFORM WITH DANA WORKMANSHIP STANDARDS
1 ALL RESISTORS ARE 1/4 W, ± 5%, CARBON
NOTE: UNLESS OTHERWISE SPECIFIED



CROSS REFERENCE CHART	
ITEM NO.	PART NO.
3.0	450188
4.0	450918
5.0	450996
7.0	500004
8.0	500005
9.0	501376
15.0	610019
16.5	610158

REF DES	B/M ITEM	DESCRIPTION
C7	2.0	50UF/350V
C18	1.0	1000UF/35V(DUAL)
C12		
C21		
C20		
C18		
C14		
C17	1.0	1000UF/35V(DUAL)
C10		

QTY REQD	SYM	ITEM NO.	GOV'T OR VENDOR NO.	DANA PART NUMBER	NOMENCLATURE OR DESCRIPTION	CODE IDENT	SPECIFICATION

LIST OF MATERIAL OR PARTS LIST

NEXT ASSY	USED ON	NA	FA
402000	5403	1	1
402319	5500	1	1
APPLICATION		QTY REQD	

MATERIAL

APPLIED FINISH

HEAT TREATMENT

UNLESS OTHERWISE SPECIFIED

DIMENSIONS ARE IN INCHES

TOLERANCES ON

DECIMALS	ANGLES
.X ± .030	± 0° 30'
.XX ± .020	
.XXX ± .010	

FORMED ANGLES ± 1.0°

ECCENTRICITY BETWEEN DIA ON THE SAME AXIS SHALL NOT EXCEED .010 TIR.

INTERPRET DRAWING IN ACCORDANCE WITH STANDARDS MIL-D-1000 AND MIL-D-70327

CONTRACT NO.

	NAME	DATE
DR	Berg	10-13-66
CHK		11/28/66
APPD		8/7/67

DRN # 651

8-12-67 CL

DANA LABORATORIES INC.
IRVINE, CALIFORNIA

CAPACITOR ASSEMBLY-5 CAP

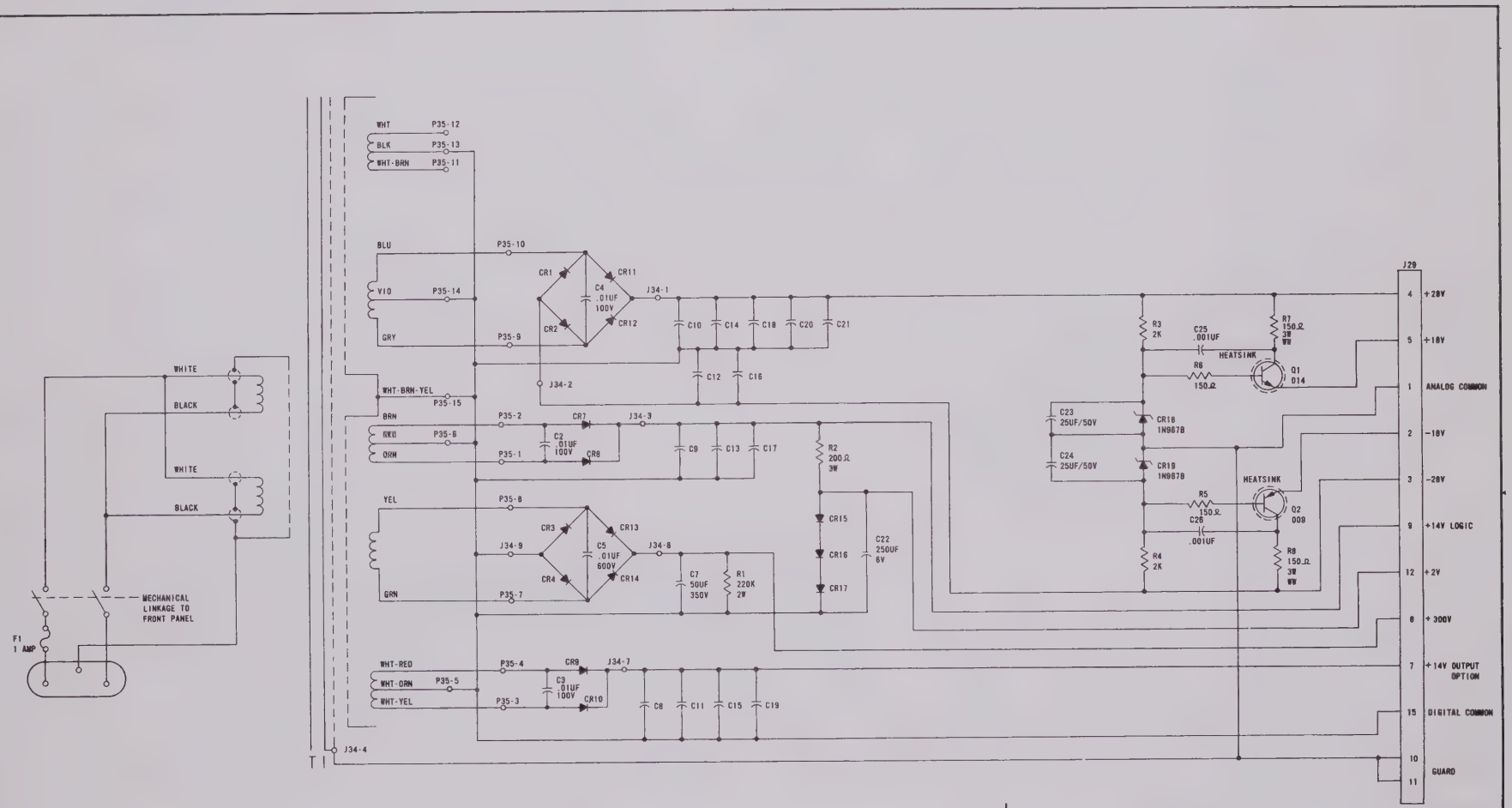
SIZE	CODE IDENT NO.	DWG NO.	
C	21793	402019	A

SCALE 1/1 | WT | SHEET 1 OF 1

2. ASSEMBLY PROCEDURES AND PROCESSES TO CONFORM WITH DANA WORKMANSHIP STANDARDS.
1. SCHEMATIC REFERENCE: 430399

NOTES: UNLESS OTHERWISE SPECIFIED

33



3. ALL CAPACITORS 1000-MICROFARADS 35 V.
2. ALL DIODES SD 4.
1. ALL RESISTORS 1/4W, CARBON 5%.

NOTE: UNLESS OTHERWISE SPECIFIED

QTY REQD	DANA PART NUMBER	NOMENCLATURE OR DESCRIPTION	CODE IDENT	SPECIFICATION OR VENDOR P/N	ITEM NO.

LIST OF MATERIAL OR PARTS LIST

102000	5403	REF	REF
NEXT ASSY	USED ON	NA	FA
APPLICATION		QTY REQD	

UNLESS OTHERWISE SPECIFIED
DIMENSIONS ARE IN INCHES
TOLERANCES ON:
DECIMALS | ANGLES | FORMED ANGLES
X .030 | 0° 30' | 1.0
XX .020
XXX .010

MATERIAL

FINISH

CONTRACT NO.

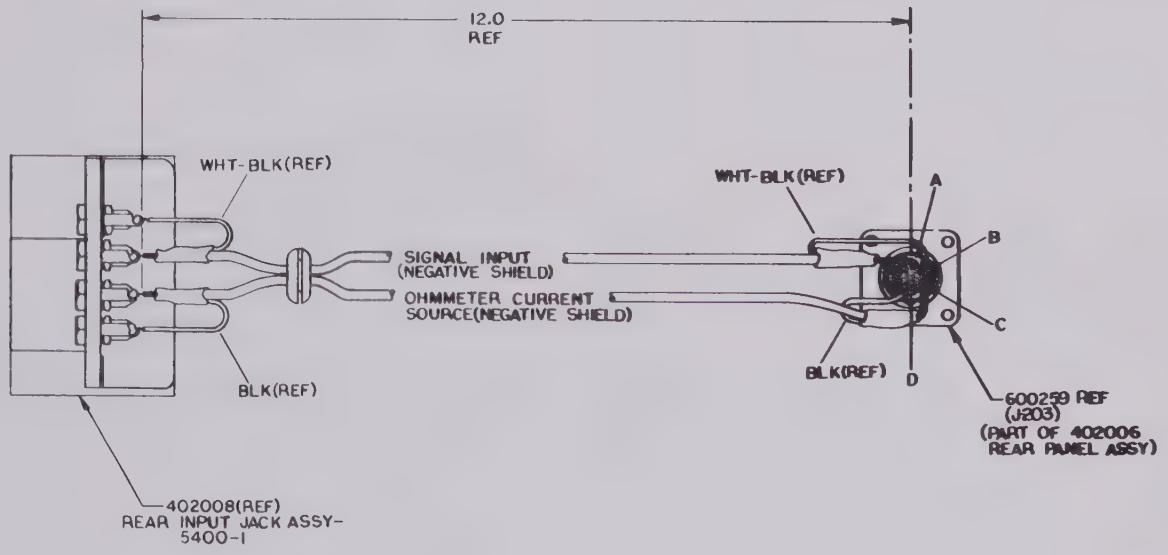
DRAWN	TM Berg	12-9-66
CHECK	[illegible]	12-16-66
COG. ENGR	D Payne	12-16-66
PROJ ENGR		

DANA LABORATORIES INC.
IRVINE, CALIFORNIA

SCHEMATIC— POWER SUPPLY,

SIZE	CODE IDENT NO.	DWG NO.	REV
D	—	430571	

SCALE — | WT — | SHEET 1 OF 1



QTY REQD	SYM	ITEM NO.	GOVT OR VENDOR NO.	DANA PART NUMBER	NOMENCLATURE OR DESCRIPTION	CODE IDENT	SPECIFICATION

LIST OF MATERIAL OR PARTS LIST

MATERIAL

APPLIED FINISH

HEAT TREATMENT

UNLESS OTHERWISE SPECIFIED

DIMENSIONS ARE IN INCHES

TOLERANCES ON DECIMALS: X ± .030; XX ± .020; XXX ± .010 — ANGLES ± 0° 30'

FORMED ANGLES ± 1.0°

ECCENTRICITY BETWEEN DIA OR THE SAME AXIS SHALL NOT EXCEED .010 TIR.

INTERPRET MARKINGS IN ACCORDANCE WITH STANDARDS MIL-D-1000 AND MIL-D-70327

CONTRACT NO.

	NAME	DATE
DR	[illegible]	26 APR 1962
CHK	[illegible]	[illegible]
APPD	[illegible]	

Rev 6-17 LL

DANA LABORATORIES INC.
IRVINE, CALIFORNIA

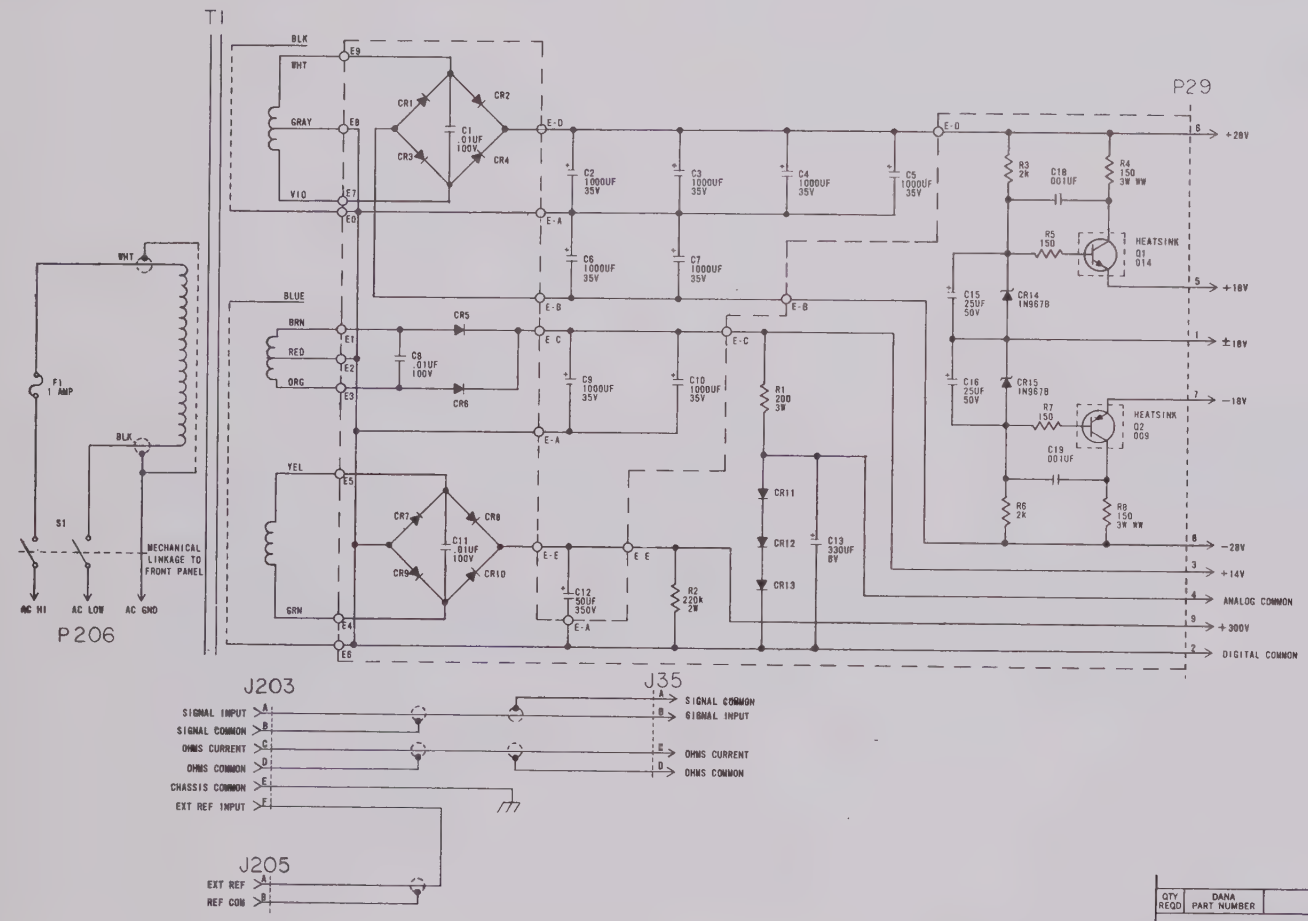
WIRING DIAGRAM — ENCLOSURE, 5400-1

SIZE	CODE IDENT NO.	DWG NO.
C	—	430400

SCALE FULL | WT — | SHEET 1 OF 1

NOTES: UNLESS OTHERWISE SPECIFIED

34



3. HIGHEST REFERENCE DESIGNATORS ARE: C18, CR15, F1, Q2, R8, T1.
2. ALL DIODES ARE 3D 4'S.
1. ALL RESISTORS ARE 1/4W, 5%, CARBON.

NOTE: UNLESS OTHERWISE SPECIFIED

QTY REQD	DANA PART NUMBER	NOMENCLATURE OR DESCRIPTION	CODE IDENT	SPECIFICATION OR VENDOR P/N	ITEM NO.

LIST OF MATERIAL OR PARTS LIST

402006	5400-1	Mat	Ref
NEXT ASSY	USED ON	NA	FA
APPLICATION		QTY REQD	

UNLESS OTHERWISE SPECIFIED
DIMENSIONS ARE IN INCHES
TOLERANCES ON:
DECIMALS: X .020, XX .010, XXX .010
ANGLES 0° 30'
FORMED ANGLES 1.0

MATERIAL
FINISH

CONTRACT NO.

DANA LABORATORIES INC.
IRVINE, CALIFORNIA

DRAWN	E. WOOD	4-20-67
CHECK	J. Mallory	5/17/67
COG. ENGR		5/18/67
PROJ ENGR		

DRAWING

SCHEMATIC - PWR SUP REAR PANEL

SIZE	CODE IDENT NO.	DWG NO.	REV
D	21793	430613	A

SCALE NONE WT SHEET 1 OF 1

PARTS LIST

ASSEMBLY 400691 DISPLAY ASSEMBLY

REF. DESIG.	PART NO.	DESCRIPTION
CR1	210004	DIODE, SILICON, TYPE SD-4
CR2	210004	DIODE, SILICON, TYPE SD-4
CR3	210004	DIODE, SILICON, TYPE SD-4
C01	110041	CAPACITOR, ELECTROLYTIC, 250UF, 6V
R01	001107	RESISTOR, CARBON, 1W, 39 KILOHM
R02	001698	RESISTOR, CARBON, 1W, 20 KILOHM
R03	000224	RESISTOR, CARBON, 1/4W, 220 KILOHM
R04	001107	RESISTOR, CARBON, 1W, 39 KILOHM
R05	001698	RESISTOR, CARBON, 1W, 20 KILOHM
R06	030005	RESISTOR, CARBON, 2W, 100 KILOHM
R07	030005	RESISTOR, CARBON, 2W, 100 KILOHM
R08	030005	RESISTOR, CARBON, 2W, 100 KILOHM
R09	030005	RESISTOR, CARBON, 2W, 100 KILOHM
R10	030005	RESISTOR, CARBON, 2W, 100 KILOHM
R11	030005	RESISTOR, CARBON, 2W, 100 KILOHM
R12	030005	RESISTOR, CARBON, 2W, 100 KILOHM
R13	030005	RESISTOR, CARBON, 2W, 100 KILOHM
R18	030012	RESISTOR, CARBON, 1W, 130 KILOHM
R19	030012	RESISTOR, CARBON, 1W, 130 KILOHM
R20	000914	RESISTOR, CARBON, 1/4W, 910 KILOHM
R21	000914	RESISTOR, CARBON, 1/4W, 910 KILOHM
R22	000914	RESISTOR, CARBON, 1/4W, 910 KILOHM
R23	000914	RESISTOR, CARBON, 1/4W, 910 KILOHM
R24	000914	RESISTOR, CARBON, 1/4W, 910 KILOHM
R25	000914	RESISTOR, CARBON, 1/4W, 910 KILOHM
R26	000914	RESISTOR, CARBON, 1/4W, 910 KILOHM
R27	000914	RESISTOR, CARBON, 1/4W, 910 KILOHM
R28	000914	RESISTOR, CARBON, 1/4W, 910 KILOHM
R29	000914	RESISTOR, CARBON, 1/4W, 910 KILOHM
R30	000914	RESISTOR, CARBON, 1/4W, 910 KILOHM

PARTS LIST

ASSEMBLY 400862 DECADE ASSEMBLY

REF. DESIG.	PART NO.	DESCRIPTION
CR1	211083	DIODE, SILICON, TYPE 018
CR2	211083	DIODE, SILICON, TYPE 018
CR3	211083	DIODE, SILICON, TYPE 018
CR4	211083	DIODE, SILICON, TYPE 018
CR25	211083	DIODE, SILICON, TYPE 018
CR36	211083	DIODE, SILICON, TYPE 018
CR37	211083	DIODE, SILICON, TYPE 018
CR38	211083	DIODE, SILICON, TYPE 018
CR39	211083	DIODE, SILICON, TYPE 018
CR40	211083	DIODE, SILICON, TYPE 018
CR41	211083	DIODE, SILICON, TYPE 018
CR42	211083	DIODE, SILICON, TYPE 018
CR43	211083	DIODE, SILICON, TYPE 018
CR44	211083	DIODE, SILICON, TYPE 018
CR45	211083	DIODE, SILICON, TYPE 018
CR46	211083	DIODE, SILICON, TYPE 018
CR47	211083	DIODE, SILICON, TYPE 018
CR48	211083	DIODE, SILICON, TYPE 018
C01	100012	CAPACITOR, CERAMIC DISC, 33PF, 500V
Q01	200037	TRANSISTOR, TYPE 2N3646
Q02	200037	TRANSISTOR, TYPE 2N3646
Q04	200035	TRANSISTOR, TYPE 014
A-R01	000122	RESISTOR, CARBON, 1/4W, 1.2 KILOHM
B-R01	000222	RESISTOR, CARBON, 1/4W, 2.2 KILOHM
C-R01	000222	RESISTOR, CARBON, 1/4W, 2.2 KILOHM
D-R01	000222	RESISTOR CARBON 1/4W 2.2 KILOHM
R2	000153	RESISTOR, CARBON, 1/4W, 15 KILOHM
A-R03	000122	RESISTOR, CARBON, 1/4W, 1.2 KILOHM
B-R03	000222	RESISTOR, CARBON, 1/4W, 2.2 KILOHM
C-R03	000222	RESISTOR, CARBON, 1/4W, 2.2 KILOHM
D-R03	000222	RESISTOR CARBON 1/4W 2.2 KILOHM
R04	000153	RESISTOR, CARBON, 1/4W, 15 KILOHM
R08	000243	RESISTOR, CARBON, 1/4W, 24 KILOHM
R09	000273	RESISTOR, CARBON, 1/4W, 27 KILOHM
R11	000204	RESISTOR, CARBON, 1/4W, 200 KILOHM
R12	000103	RESISTOR, CARBON, 1/4W, 10 KILOHM
R13	000103	RESISTOR, CARBON, 1/4W, 10 KILOHM
R14	001698	RESISTOR, CARBON, 1W, 20 KILOHM

PARTS LIST

ASSEMBLY 400862 DECADE ASSEMBLY

REF. DESIG.	PART NO.	DESCRIPTION
R15	001107	RESISTOR, CARBON, 1W, 39 KILOHM
R16	000103	RESISTOR, CARBON, 1/4W, 10 KILOHM
R17	000103	RESISTOR, CARBON, 1/4W, 10 KILOHM
R18	000103	RESISTOR, CARBON, 1/4W, 10 KILOHM
R19	001107	RESISTOR, CARBON, 1W, 39 KILOHM
R20	001698	RESISTOR, CARBON, 1W, 20 KILOHM
R21	000333	RESISTOR, CARBON, 1/4W, 33 KILOHM
R22	000333	RESISTOR, CARBON, 1/4W, 33 KILOHM
R23	000333	RESISTOR, CARBON, 1/4W, 33 KILOHM
R24	000333	RESISTOR, CARBON, 1/4W, 33 KILOHM
R25	000333	RESISTOR, CARBON, 1/4W, 33 KILOHM
R26	000333	RESISTOR, CARBON, 1/4W, 33 KILOHM
R27	000223	RESISTOR, CARBON, 1/4W, 22 KILOHM
R28	000223	RESISTOR, CARBON, 1/4W, 22 KILOHM
R29	000223	RESISTOR, CARBON, 1/4W, 22 KILOHM
R30	000223	RESISTOR, CARBON, 1/4W, 22 KILOHM

PARTS LIST

ASSEMBLY 400891 DECADE ASSEMBLY

REF. DESIG.	PART NO.	DESCRIPTION
CR1	211083	DIODE, SILICON, TYPE 018
CR2	211083	DIODE, SILICON, TYPE 018
CR3	211083	DIODE, SILICON, TYPE 018
CR4	211083	DIODE, SILICON, TYPE 018
CR5	211083	DIODE, SILICON, TYPE 018
CR6	211083	DIODE, SILICON, TYPE 018
CR7	211083	DIODE, SILICON, TYPE 018
CR8	211083	DIODE, SILICON, TYPE 018
CR9	211083	DIODE, SILICON, TYPE 018
CR10	211083	DIODE, SILICON, TYPE 018
CR11	211083	DIODE, SILICON, TYPE 018
CR12	211083	DIODE, SILICON, TYPE 018
CR13	211083	DIODE, SILICON, TYPE 018
CR14	211083	DIODE, SILICON, TYPE 018
CR15	211083	DIODE, SILICON, TYPE 018
CR16	211083	DIODE, SILICON, TYPE 018
CR17	211083	DIODE, SILICON, TYPE 018
CR18	211083	DIODE, SILICON, TYPE 018
CR19	211083	DIODE, SILICON, TYPE 018
CR20	211083	DIODE, SILICON, TYPE 018
CR21	211083	DIODE, SILICON, TYPE 018
CR22	211083	DIODE, SILICON, TYPE 018
CR23	211083	DIODE, SILICON, TYPE 018
CR24	211083	DIODE, SILICON, TYPE 018
CR25	211083	DIODE, SILICON, TYPE 018
CR36	211083	DIODE, SILICON, TYPE 018
CR37	211083	DIODE, SILICON, TYPE 018
CR38	211083	DIODE, SILICON, TYPE 018
CR39	211083	DIODE, SILICON, TYPE 018
CR40	211083	DIODE, SILICON, TYPE 018
CR41	211083	DIODE, SILICON, TYPE 018
CR42	211083	DIODE, SILICON, TYPE 018
CR43	211083	DIODE, SILICON, TYPE 018
CR44	211083	DIODE, SILICON, TYPE 018
CR45	211083	DIODE, SILICON, TYPE 018
CR46	211083	DIODE, SILICON, TYPE 018
CR47	211083	DIODE, SILICON, TYPE 018
CR48	211083	DIODE, SILICON, TYPE 018

PARTS LIST

ASSEMBLY 400891 DECADE ASSEMBLY

REF. DESIG.	PART NO.	DESCRIPTION
C01	100012	CAPACITOR, CERAMIC DISC, 33PF, 500V
Q01	200037	TRANSISTOR, TYPE 2N3646
Q02	200037	TRANSISTOR, TYPE 2N3646
Q04	200035	TRANSISTOR, TYPE 014
R01	000122	RESISTOR, CARBON, 1/4W, 1.2 KILOHM
R02	000153	RESISTOR, CARBON, 1/4W, 15 KILOHM
R03	000122	RESISTOR, CARBON, 1/4W, 1.2 KILOHM
R04	000153	RESISTOR, CARBON, 1/4W, 15 KILOHM
R08	000243	RESISTOR, CARBON, 1/4W, 24 KILOHM
R09	000273	RESISTOR, CARBON, 1/4W, 27 KILOHM
R11	000204	RESISTOR, CARBON, 1/4W, 200 KILOHM
R12	000103	RESISTOR, CARBON, 1/4W, 10 KILOHM
R13	000103	RESISTOR, CARBON, 1/4W, 10 KILOHM
R14	001698	RESISTOR, CARBON, 1W, 20 KILOHM
R15	001107	RESISTOR- 39K 1/4 W CARBON
R16	000103	RESISTOR, CARBON, 1/4W, 10 KILOHM
R17	000103	RESISTOR, CARBON, 1/4W, 10 KILOHM
R18	000103	RESISTOR, CARBON, 1/4W, 10 KILOHM
R19	001107	RESISTOR, CARBON, 1W, 39 KILOHM
R20	001698	RESISTOR, CARBON, 1W, 20 KILOHM
R21	000103	RESISTOR, CARBON, 1/4W, 10 KILOHM
R22	000103	RESISTOR, CARBON, 1/4W, 10 KILOHM
R23	000103	RESISTOR, CARBON, 1/4W, 10 KILOHM
R24	000103	RESISTOR, CARBON, 1/4W, 10 KILOHM
R25	000103	RESISTOR, CARBON, 1/4W, 10 KILOHM
R26	000103	RESISTOR, CARBON, 1/4W, 10 KILOHM
R27	000223	RESISTOR, CARBON, 1/4W, 22 KILOHM
R28	000223	RESISTOR, CARBON, 1/4W, 22 KILOHM
R29	000223	RESISTOR, CARBON, 1/4W, 22 KILOHM
R30	000223	RESISTOR, CARBON, 1/4W, 22 KILOHM
R31	000563	RESISTOR, CARBON, 1/4W, 56 KILOHM
R32	000563	RESISTOR, CARBON, 1/4W, 56 KILOHM
R33	000473	RESISTOR, CARBON, 1/4W, 47 KILOHM
R34	000473	RESISTOR, CARBON, 1/4W, 47 KILOHM
R35	000473	RESISTOR, CARBON, 1/4W, 47 KILOHM
R36	000473	RESISTOR, CARBON, 1/4W, 47 KILOHM
R37	000473	RESISTOR, CARBON, 1/4W, 47 KILOHM
R38	000204	200K 1/4 W 5%

PARTS LIST

ASSEMBLY 400891 DECADE ASSEMBLY

REF. DESIG.	PART NO.	DESCRIPTION

PARTS LIST

ASSEMBLY 400843 NULL DETECTOR ASSEMBLY

REF. DESIG.	PART NO.	DESCRIPTION
Q01	200037	TRANSISTOR, TYPE 2N3646
A-Q02	200055	TRANSISTOR, TYPE 2N3714 SELECTED
B-Q02	200055	TRANSISTOR, TYPE 2N3714 SELECTED
C-Q02	200055	TRANSISTOR, TYPE 2N3714 SELECTED
D-Q02	200055	TRANSISTOR, TYPE 2N3714 SELECTED
E-Q02	200055	TRANSISTOR, TYPE 2N3714 SELECTED
F-Q02	200055	TRANSISTOR, TYPE 2N3714 SELECTED
G-Q02	200055	TRANSISTOR, TYPE 2N3714 SELECTED
H-Q02	200055	TRANSISTOR, TYPE 2N3714 SELECTED
I-Q02	200055	TRANSISTOR, TYPE 2N3714 SELECTED
J-Q02	200055	TRANSISTOR, TYPE 2N3714 SELECTED
K-Q02	200055	TRANSISTOR, TYPE 2N3714 SELECTED
L-Q02	200055	TRANSISTOR, TYPE 2N3714 SELECTED
M-Q02	200055	TRANSISTOR, TYPE 2N3714 SELECTED
N-Q02	200055	TRANSISTOR, TYPE 2N3714 SELECTED
P-Q02	200054	TRANSISTOR, TYPE 2N3714 SELECTED
Q-Q02	200054	TRANSISTOR, TYPE 2N3714 SELECTED
R-Q02	200054	TRANSISTOR, TYPE 2N3714 SELECTED
S-Q02	200054	TRANSISTOR, TYPE 2N3714 SELECTED
T-Q02	200054	TRANSISTOR, TYPE 2N3714 SELECTED
U-Q02	200054	TRANSISTOR, TYPE 2N3714 SELECTED
V-Q02	200054	TRANSISTOR, TYPE 2N3714 SELECTED
Q03	200036	TRANSISTOR, TYPE 015
Q04	200043	TRANSISTOR, TYPE 2N3565
Q05	200043	TRANSISTOR, TYPE 2N3565
Q06	200043	TRANSISTOR, TYPE 2N3565
Q07	200043	TRANSISTOR, TYPE 2N3565
Q08	200043	TRANSISTOR, TYPE 2N3565
Q09	200043	TRANSISTOR, TYPE 2N3565
R01	000473	RESISTOR, CARBON, 1/4W, 47 KILOHM
R02	000333	RESISTOR, CARBON, 1/4W, 33 KILOHM
R03	000204	RESISTOR, CARBON, 1/4W, 200 KILOHM
R04	040050	RESISTOR, VARIABLE, 1/2W, 5 KILOHM
R05	020193	RESISTOR, PRECISION, .01%, 4948.22 OHM
R06	000684	RESISTOR, CARBON, 1/4W, 680 KILOHM
R07	020194	RESISTOR, PRECISION, .01%, 2400.09 OHM
R08	000104	RESISTOR, CARBON, 1/4W, 100 KILOHM
R09	000516	RES 51 MEGOHM 1/4 W 5% CARBON

PARTS LIST

ASSEMBLY 400843 NULL DETECTOR ASSEMBLY

REF. DESIG.	PART NO.	DESCRIPTION	
R10	000104	RESISTOR, CARBON, 1/4W, 100 KILOHM	
R11	000133	RESISTOR, CARBON, 1/4W, 13 KILOHM	
R12	000432	RESISTOR, CARBON, 1/4W, 4.3 KILOHM	
R13	000246	RES 24 MEG 1/4 W 5% CARBON	
R14	000104	RESISTOR, CARBON, 1/4W, 100 KILOHM	
R15	000331	RESISTOR, CARBON, 1/4W, 330 OHM	
R16	010113	RESISTOR, PRECISION, 1%, 15.0 KILOHM	
R17	000246	RES 24 MEG 1/4 W 5% CARBON	
R18	040049	RESISTOR, VARIABLE, 1/2W, 2 KILOHM	
R19	010272	RESISTOR, PRECISION, 1%, 154 KILOHM	
R20	000104	RESISTOR, CARBON, 1/4W, 100 KILOHM	
R21	010113	RESISTOR, PRECISION, 1%, 15.0 KILOHM	
R22	010270	RESISTOR, PRECISION, 1%, 12.5 MEGOHM	
R23	000104	RESISTOR, CARBON, 1/4W, 100 KILOHM	
R24	010269	RESISTOR, PRECISION, 1%, 5 MEGOHM	
R25	000334	RESISTOR, CARBON, 1/4W, 330 KILOHM	
R26	000104	RESISTOR, CARBON, 1/4W, 100 KILOHM	
R27	000123	RESISTOR, CARBON, 1/4W, 12 KILOHM	
R28	010298	RESISTOR, PRECISION, .25%, 2.5 MEGOHM	DELETED REV. J
R29	000242	RESISTOR, CARBON, 1/4W, 2.4 KILOHM	
R30	000113	RESISTOR, CARBON, 1/4W, 11 KILOHM	
R31	000104	RESISTOR, CARBON, 1/4W, 100 KILOHM	
R32	000123	RESISTOR, CARBON, 1/4W, 12 KILOHM	
R33	010298	RESISTOR, PRECISION, .25%, 2.5 MEGOHM	
R34	000334	RESISTOR, CARBON, 1/4W, 330 KILOHM	
R35	000104	RESISTOR, CARBON, 1/4W, 100 KILOHM	
R36	010297	RESISTOR, PRECISION, .1%, 1.25 MEGOHM	
R37	000104	RESISTOR, CARBON, 1/4W, 100 KILOHM	
R38	001692	RESISTOR, CARBON, 1/2W, 4.7 KILOHM	
R39	010267	RESISTOR, PRECISION, .1%, 500 KILOHM	
R40	001703	RESISTOR, CARBON, 1/2W, 8.2 KILOHM	
R41	001692	RESISTOR, CARBON, 1/2W, 4.7 KILOHM	
R42	000104	RESISTOR, CARBON, 1/4W, 100 KILOHM	
R43	020198	RESISTOR, PRECISION, .05%, 250 KILOHM	
R44	000104	RESISTOR, CARBON, 1/4W, 100 KILOHM	
R45	020198	RESISTOR, PRECISION, .05%, 250 KILOHM	
R46	000273	RESISTOR, CARBON, 1/4W, 27 KILOHM	
R47	000124	RESISTOR, CARBON, 1/4W, 123 KILOHM	

PARTS LIST

ASSEMBLY 400843 NULL DETECTOR ASSEMBLY

REF. DESIG.	PART NO.	DESCRIPTION
R48	000104	RESISTOR, CARBON, 1/4W, 100 KILOHM
R49	020197	RESISTOR, PRECISION, .05%, 125 KILOHM
R50	020195	RESISTOR, PRECISION, .01%, 49.995 KILOHM
R51	020196	RESISTOR, PRECISION, .01%, 24.995 KILOHM
R52	020196	RESISTOR, PRECISION, .01%, 24.995 KILOHM
R53	020196	RESISTOR, PRECISION, .01%, 24.995 KILOHM
R54	020196	RESISTOR, PRECISION, .01%, 24.995 KILOHM
R55	020195	RESISTOR, PRECISION, .01%, 49.995 KILOHM

PARTS LIST

ASSEMBLY 400688 SEQUENCE LOGIC ASSEMBLY

REF. DESIG.	PART NO.	DESCRIPTION
CR1	211083	DIODE, SILICON, TYPE 018
CR2	211083	DIODE, SILICON, TYPE 018
CR3	211083	DIODE, SILICON, TYPE 018
CR4	211083	DIODE, SILICON, TYPE 018
CR5	211083	DIODE, SILICON, TYPE 018
CR6	211083	DIODE, SILICON, TYPE 018
CR7	211083	DIODE, SILICON, TYPE 018
CR25	211083	DIODE, SILICON, TYPE 018
C01	100012	CAPACITOR, CERAMIC DISC, 33PF, 500V
C1C	101175	CAPACITOR, CERAMIC DISC, 220PF, 500V
Q01	200037	TRANSISTOR, TYPE 2N3646
Q02	200037	TRANSISTOR, TYPE 2N3646
R01	000222	RESISTOR, CARBON, 1/4W, 2.2 KILOHM
R-R01	000822	RESISTOR, CARBON, 1/4W, 8.2 KILOHM
R02	000153	RESISTOR, CARBON, 1/4W, 15 KILOHM
R03	000222	RESISTOR, CARBON, 1/4W, 2.2 KILOHM
R-R03	000822	RESISTOR, CARBON, 1/4W, 8.2 KILOHM
R04	000153	RESISTOR, CARBON, 1/4W, 15 KILOHM
R08	000123	RESISTOR, CARBON, 1/4W, 12 KILOHM
R10	000273	RESISTOR, CARBON, 1/4W, 27 KILOHM

PARTS LIST

ASSEMBLY 400689 CONTROL LOGIC ASSEMBLY

REF. DESIG.	PART NO.	DESCRIPTION
CR1	211083	DIODE, SILICON, TYPE 018
CR2	211083	DIODE, SILICON, TYPE 018
CR3	211083	DIODE, SILICON, TYPE 018
CR4	211083	DIODE, SILICON, TYPE 018
CR5	211083	DIODE, SILICON, TYPE 018
CR6	211083	DIODE, SILICON, TYPE 018
CR7	211083	DIODE, SILICON, TYPE 018
CR8	211083	DIODE, SILICON, TYPE 018
CR9	211083	DIODE, SILICON, TYPE 018
CR10	211083	DIODE, SILICON, TYPE 018
CR11	211083	DIODE, SILICON, TYPE 018
CR12	211083	DIODE, SILICON, TYPE 018
CR13	211083	DIODE, SILICON, TYPE 018
CR14	211083	DIODE, SILICON, TYPE 018
CR15	211083	DIODE, SILICON, TYPE 018
CR16	211083	DIODE, SILICON, TYPE 018
CR17	211083	DIODE, SILICON, TYPE 018
CR18	211083	DIODE, SILICON, TYPE 018
CR19	211083	DIODE, SILICON, TYPE 018
CR20	211083	DIODE, SILICON, TYPE 018
CR21	211083	DIODE, SILICON, TYPE 018
CR22	211083	DIODE, SILICON, TYPE 018
CR23	211083	DIODE, SILICON, TYPE 018
CR24	211083	DIODE, SILICON, TYPE 018
CR25	211083	DIODE, SILICON, TYPE 018
CR26	211083	DIODE, SILICON, TYPE 018
CR27	211083	DIODE, SILICON, TYPE 018
CR28	211083	DIODE, SILICON, TYPE 018
CR29	211083	DIODE, SILICON, TYPE 018
CR30	211083	DIODE, SILICON, TYPE 018
CR31	211083	DIODE, SILICON, TYPE 018
CR32	211083	DIODE, SILICON, TYPE 018
CR33	211083	DIODE, SILICON, TYPE 018
CR34	211083	DIODE, SILICON, TYPE 018
CR35	211083	DIODE, SILICON, TYPE 018
CR36	211083	DIODE, SILICON, TYPE 018
C01	100012	CAPACITOR, CERAMIC DISC, 33PF, 500V
C02	121473	CAPACITOR, MYLAR, 1.5NF, 100V

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PARTS LIST

ASSEMBLY 400689 CONTROL LOGIC ASSEMBLY

REF. DESIG.	PART NO.	DESCRIPTION	
C03	121090	CAPACITOR, MYLAR, 15NF, 100V	
C04	101174	CAPACITOR, CERAMIC DISC, 1NF, 500V	
C05	120001	CAPACITOR, MYLAR, 3.3NF, 100V	
C06	110017	CAPACITOR, TANTALUM, 1UF, 35V	
C07	110039	CAPACITOR, ELECTROLYTIC, 5UF, 50V	
C08	110039	CAPACITOR, ELECTROLYTIC, 5UF, 50V	
C09	110043	CAPACITOR, ELECTROLYTIC, 25UF, 25V	
Q01	200037	TRANSISTOR, TYPE 2N3646	
Q02	200037	TRANSISTOR, TYPE 2N3646	
Q03	200037	TRANSISTOR, TYPE 2N3646	
Q04	200037	TRANSISTOR, TYPE 2N3646	
Q05	200011	TRANSISTOR, TYPE 009	
Q06	200037	TRANSISTOR, TYPE 2N3646	
Q07	200037	TRANSISTOR, TYPE 2N3646	
Q08	200037	TRANSISTOR, TYPE 2N3646	
Q09	200037	TRANSISTOR, TYPE 2N3646	
Q11	200035	TRANSISTOR, TYPE 014	
R01	000222	RESISTOR, CARBON, 1/4W, 2.2 KILOHM	
R02	000153	RESISTOR, CARBON, 1/4W, 15 KILOHM	
R03	000222	RESISTOR, CARBON, 1/4W, 2.2 KILOHM	
R04	000153	RESISTOR, CARBON, 1/4W, 15 KILOHM	
R05	000622	RESISTOR, CARBON, 1/4W, 6.2 KILOHM	
R06	000153	RESISTOR, CARBON, 1/4W, 15 KILOHM	
R07	000242	RESISTOR, CARBON, 1/4W, 2.4 KILOHM	
R08	000822	RESISTOR, CARBON, 1/4W, 8.2 KILOHM	
R09	000204	RESISTOR, CARBON, 1/4W, 200 KILOHM	DELETED REV. L
R10	000273	RESISTOR, CARBON, 1/4W, 27 KILOHM	
R11	000201	RESISTOR, CARBON, 1/4W, 200 OHM	
R12	000243	RESISTOR, CARBON, 1/4W, 24 KILOHM	
R13	000153	RESISTOR, CARBON, 1/4W, 15 KILOHM	
R14	000822	RESISTOR, CARBON, 1/4W, 8.2 KILOHM	
R15	000104	RESISTOR, CARBON, 1/4W, 100 KILOHM	
R16	000153	RESISTOR, CARBON, 1/4W, 15 KILOHM	
R17	000104	RESISTOR, CARBON, 1/4W, 100 KILOHM	
R18	001469	RESISTOR, CARBON, 1/2W, 1.2 KILOHM	
R19	000203	RESISTOR, CARBON, 1/4W, 20 KILOHM	
R20	000203	RESISTOR, CARBON, 1/4W, 20 KILOHM	
R21	001469	RESISTOR, CARBON, 1/2W, 1.2 KILOHM	

PARTS LIST

ASSEMBLY 400689 CONTROL LOGIC ASSEMBLY

REF. DESIG.	PART NO.	DESCRIPTION
R22	000104	RESISTOR, CARBON, 1/4W, 100 KILOHM
R23	000153	RESISTOR, CARBON, 1/4W, 15 KILOHM
R24	000104	RESISTOR, CARBON, 1/4W, 100 KILOHM
R25	000222	RESISTOR, CARBON, 1/4W, 2.2 KILOHM
R26	000223	RESISTOR, CARBON, 1/4W, 22 KILOHM
R27	040003	RESISTOR, VARIABLE, 1/2W, 20 KILOHM
R28	000222	RESISTOR, CARBON, 1/4W, 2.2 KILOHM
R29	000104	RESISTOR, CARBON, 1/4W, 100 KILOHM
R30	000273	RESISTOR, CARBON, 1/4W, 27 KILOHM
R31	000103	RESISTOR, CARBON, 1/4W, 10 KILOHM
R32	000103	RESISTOR, CARBON, 1/4W, 10 KILOHM
R33	000103	RESISTOR, CARBON, 1/4W, 10 KILOHM
R34	000103	RESISTOR, CARBON, 1/4W, 10 KILOHM
R35	000822	RESISTOR, CARBON, 1/4W, 8.2 KILOHM

PARTS LIST

ASSEMBLY 402502 PCB ASSEMBLY- CONTROL LOGIC

REF. DESIG.	PART NO.	DESCRIPTION
CR1	211083	DIODE, SILICON, TYPE 018
CR2	211083	DIODE, SILICON, TYPE 018
CR3	211083	DIODE, SILICON, TYPE 018
CR4	211083	DIODE, SILICON, TYPE 018
CR5	211083	DIODE, SILICON, TYPE 018
CR6	211083	DIODE, SILICON, TYPE 018
CR7	211083	DIODE, SILICON, TYPE 018
CR8	211083	DIODE, SILICON, TYPE 018
CR9	211083	DIODE, SILICON, TYPE 018
CR10	211083	DIODE, SILICON, TYPE 018
CR11	211083	DIODE, SILICON, TYPE 018
CR12	211083	DIODE, SILICON, TYPE 018
CR13	211083	DIODE, SILICON, TYPE 018
CR14	211083	DIODE, SILICON, TYPE 018
CR15	211083	DIODE, SILICON, TYPE 018
CR16	211083	DIODE, SILICON, TYPE 018
CR17	211083	DIODE, SILICON, TYPE 018
CR18	211083	DIODE, SILICON, TYPE 018
CR19	211083	DIODE, SILICON, TYPE 018
CR20	211083	DIODE, SILICON, TYPE 018
C21	211083	DICR21 SILICON, TYPE 018
CR22	211083	DIODE, SILICON, TYPE 018
CR23	211083	DIODE, SILICON, TYPE 018
CR24	211083	DIODE, SILICON, TYPE 018
CR25	211083	DIODE, SILICON, TYPE 018
CR26	211083	DIODE, SILICON, TYPE 018
CR27	211083	DIODE, SILICON, TYPE 018
CR28	211083	DIODE, SILICON, TYPE 018
CR29	211083	DIODE, SILICON, TYPE 018
CR30	211083	DIODE, SILICON, TYPE 018
CR31	211083	DIODE, SILICON, TYPE 018
CR32	211083	DIODE, SILICON, TYPE 018
CR33	211083	DIODE, SILICON, TYPE 018
CR34	211083	DIODE, SILICON, TYPE 018
CR35	211083	DIODE, SILICON, TYPE 018
CR36	211083	DIODE, SILICON, TYPE 018
CR37	211083	DIODE, SILICON, TYPE 018
CR38	211083	DIODE, SILICON, TYPE 018

PARTS LIST

ASSEMBLY 402502 PCB ASSEMBLY- CONTROL LOGIC

REF. DESIG.	PART NO.	DESCRIPTION
C01	100012	CAPACITOR, CERAMIC DISC, 33PF, 500V
C02	121473	CAPACITOR, MYLAR, 1.5NF, 100V
C03	121090	CAPACITOR, MYLAR, 15NF, 100V
C4	101174	CAPACITOR, CERAMIC DISC, 1NF, 500V
C05	120001	CAPACITOR, MYLAR, 3.3NF, 100V
C06	110017	CAPACITOR, TANTALUM, 1UF, 35V
C07	110039	CAPACITOR, ELECTROLYTIC, 5UF, 50V
C08	110039	CAPACITOR, ELECTROLYTIC, 5UF, 50V
C09	110043	CAPACITOR, ELECTROLYTIC, 25UF, 25V
Q01	200037	TRANSISTOR, TYPE 2N3646
Q02	200037	TRANSISTOR, TYPE 2N3646
Q03	200037	TRANSISTOR, TYPE 2N3646
Q04	200037	TRANSISTOR, TYPE 2N3646
Q06	200037	TRANSISTOR, TYPE 2N3646
Q07	200037	TRANSISTOR, TYPE 2N3646
Q08	200037	TRANSISTOR, TYPE 2N3646
Q09	200037	TRANSISTOR, TYPE 2N3646
Q10	200035	TRANSISTOR, TYPE 014
Q11	200035	TRANSISTOR, TYPE 014
R01	000222	RESISTOR, CARBON, 1/4W, 2.2 KILOHM
R02	000153	RESISTOR, CARBON, 1/4W, 15 KILOHM
R03	000222	RESISTOR, CARBON, 1/4W, 2.2 KILOHM
R04	000153	RESISTOR, CARBON, 1/4W, 15 KILOHM
R05	000622	RESISTOR, CARBON, 1/4W, 6.2 KILOHM
R06	000153	RESISTOR, CARBON, 1/4W, 15 KILOHM
R07	000242	RESISTOR, CARBON, 1/4W, 2.4 KILOHM
R08	000123	RESISTOR, CARBON, 1/4W, 12 KILOHM
R-R08	000432	RESISTOR, CARBON, 1/4W, 4.3 KILOHM
R09	000204	RESISTOR, CARBON, 1/4W, 200 KILOHM
R10	000273	RESISTOR, CARBON, 1/4W, 27 KILOHM
R11	000201	RESISTOR, CARBON, 1/4W, 200 OHM
R13	000153	RESISTOR, CARBON, 1/4W, 15 KILOHM
R14	000822	RESISTOR, CARBON, 1/4W, 8.2 KILOHM
R15	000104	RESISTOR, CARBON, 1/4W, 100 KILOHM
R16	000153	RESISTOR, CARBON, 1/4W, 15 KILOHM
R17	000104	RESISTOR, CARBON, 1/4W, 100 KILOHM
R18	001469	RESISTOR, CARBON, 1/2W, 1.2 KILOHM
R19	000203	RESISTOR, CARBON, 1/4W, 20 KILOHM

PARTS LIST

ASSEMBLY 402502 PCB ASSEMBLY- CONTROL LOGIC

REF. DESIG.	PART NO.	DESCRIPTION
R20	000205	RESISTOR, CARBON, 1/4W, 2 MEGOHM
R21	001469	RESISTOR, CARBON, 1/2W, 1.2 KILOHM
R22	000104	RESISTOR, CARBON, 1/4W, 100 KILOHM
R23	000153	RESISTOR, CARBON, 1/4W, 15 KILOHM
R24	000104	RESISTOR, CARBON, 1/4W, 100 KILOHM
R26	000223	RESISTOR, CARBON, 1/4W, 22 KILOHM
R27	040003	RESISTOR, VARIABLE, 1/2W, 20 KILOHM
R28	000222	RESISTOR, CARBON, 1/4W, 2.2 KILOHM
R29	000104	RESISTOR, CARBON, 1/4W, 100 KILOHM
R30	000273	RESISTOR, CARBON, 1/4W, 27 KILOHM
R31	000103	RESISTOR, CARBON, 1/4W, 10 KILOHM
R32	000103	RESISTOR, CARBON, 1/4W, 10 KILOHM
R33	000103	RESISTOR, CARBON, 1/4W, 10 KILOHM
R34	000103	RESISTOR, CARBON, 1/4W, 10 KILOHM
R35	000822	RESISTOR, CARBON, 1/4W, 8.2 KILOHM

PARTS LIST

ASSEMBLY 400840 REFERENCE & BUFFER AMPLIFIER ASSEMBLY

REF. DESIG.	PART NO.	DESCRIPTION
CR1	220007	DIODE, ZENER, TYPE 1N751
CR2	211236	DIODE, TYPE 007 SELECTED
CR4	211083	DIODE, SILICON, TYPE 018
CR5	211083	DIODE, SILICON, TYPE 018
CR6	211236	DIODE, TYPE 007 SELECTED
CR7	211236	DIODE, TYPE 007 SELECTED
CR8	220012	DIODE, ZENER, TYPE 1N958B
CR9	220012	DIODE, ZENER, TYPE 1N958B
CR10	211083	DIODE, SILICON, TYPE 018
CR11	211083	DIODE, SILICON, TYPE 018
CR12	211083	DIODE, SILICON, TYPE 018
CR13	220004	DIODE, ZENER, TYPE 1N961B
C01	101098	CAPACITOR, CERAMIC DISC, 330PF, 500V
C02	101642	CAPACITOR, CERAMIC DISC, 150PF, 500V
C03	111262	CAPACITOR, ELECTROLYTIC, 10UF, 25V
C04	121393	CAPACITOR, MYLAR, 220NF, 100V
C05	110036	CAPACITOR, ELECTROLYTIC, 25UF, 50V
C06	110036	CAPACITOR, ELECTROLYTIC, 25UF, 50V
C07	110036	CAPACITOR, ELECTROLYTIC, 25UF, 50V
C08	120005	CAPACITOR, MYLAR, 1NF, 100V
C09	120005	CAPACITOR, MYLAR, 1NF, 100V
C10	101145	CAPACITOR, CERAMIC DISC, 100PF, 500V
C12	121092	CAPACITOR, MYLAR, 2.2NF, 100V
Q01	200040	TRANSISTOR, TYPE 016
Q02	200043	TRANSISTOR, TYPE 2N3565
Q03	200043	TRANSISTOR, TYPE 2N3565
Q04	200011	TRANSISTOR, TYPE 009
Q05	200035	TRANSISTOR, TYPE 014
Q06	200043	TRANSISTOR, TYPE 2N3565
Q07	200043	TRANSISTOR, TYPE 2N3565
Q08	200043	TRANSISTOR, TYPE 2N3565
Q09	200043	TRANSISTOR, TYPE 2N3565
Q10	200011	TRANSISTOR, TYPE 009
Q11	200035	TRANSISTOR, TYPE 014
Q12	200035	TRANSISTOR, TYPE 014
Q13	200011	TRANSISTOR, TYPE 009
R01	000512	RESISTOR, CARBON, 1/4W, 5.1 KILOHM
R02	400842	BRIDGE ELEMENT ASSEMBLY, AGED

PARTS LIST

ASSEMBLY 400840 REFERENCE & BUFFER AMPLIFIER ASSEMBLY

REF. DESIG.	PART NO.	D E S C R I P T I O N	
R03	000300	RESISTOR CARBON 30 OHM 1/4W 5%	DELETED REV. P
R04	400842	BRIDGE ELEMENT ASSEMBLY, AGED	
R05	040050	RESISTOR, VARIABLE, 1/2W, 5 KILOHM	
R06	400842	BRIDGE ELEMENT ASSEMBLY, AGED	
R07	000681	RESISTOR, CARBON, 1/4W, 680 OHM	
R08	010158	RESISTOR, PRECISION, 1%, 200 KILOHM	
R09	040054	RESISTOR, VARIABLE, 1/2W, 50 KILOHM	
R10	010208	RESISTOR, PRECISION, 1%, 182 KILOHM	
R11	010158	RESISTOR, PRECISION, 1%, 200 KILOHM	
R12	000122	RESISTOR, CARBON, 1/4W, 1.2 KILOHM	
R13	000101	RESISTOR, CARBON, 1/4W, 100 OHM	
R14	000273	RESISTOR, CARBON, 1/4W, 27 KILOHM	
R15	000242	RESISTOR, CARBON, 1/4W, 2.4 KILOHM	
R16	000101	RESISTOR, CARBON, 1/4W, 100 OHM	
R17	000105	RESISTOR, CARBON, 1/4W, 1 MEGOHM	
R18	000622	RESISTOR, CARBON, 1/4W, 6.2 KILOHM	
R19	000363	RESISTOR, CARBON, 1/4W, 36 KILOHM	
R20	000622	RESISTOR, CARBON, 1/4W, 6.2 KILOHM	
R21	000105	RESISTOR, CARBON, 1/4W, 1 MEGOHM	
R22	000242	RESISTOR, CARBON, 1/4W, 2.4 KILOHM	
R23	000102	RESISTOR, CARBON, 1/4W, 1 KILOHM	
R24	000473	RESISTOR, CARBON, 1/4W, 47 KILOHM	
R25	000102	RESISTOR, CARBON, 1/4W, 1 KILOHM	
R26	000471	RESISTOR, CARBON, 1/4W, 470 OHM	
R27	000682	RESISTOR, CARBON, 1/4W, 6.8 KILOHM	
R28	000240	RESISTOR, CARBON, 1/4W, 24 OHM	
R29	000240	RESISTOR, CARBON, 1/4W, 24 OHM	
R30	001702	RESISTOR, CARBON, 1/2W, 1.6 KILOHM	
R31	001702	RESISTOR, CARBON, 1/2W, 1.6 KILOHM	
R32	000102	RESISTOR, CARBON, 1/4W, 1 KILOHM	
R33	000681	RESISTOR, CARBON, 1/4W, 680 OHM	

PARTS LIST

ASSEMBLY 400684 REAR PANEL ASSY 5400

REF. DESIG.	PART NO.	DESCRIPTION
C02	110034	CAPACITOR, ELECTROLYTIC, 2X1000UF, 50V
C03	110034	CAPACITOR, ELECTROLYTIC, 2X1000UF, 50V
C04	110034	CAPACITOR, ELECTROLYTIC, 2X1000UF, 50V
C05	110034	CAPACITOR, ELECTROLYTIC, 2X1000UF, 50V
C06	110034	CAPACITOR, ELECTROLYTIC, 2X1000UF, 50V
C07	110034	CAPACITOR, ELECTROLYTIC, 2X1000UF, 50V
C09	110034	CAPACITOR, ELECTROLYTIC, 2X1000UF, 50V
C10	110034	CAPACITOR, ELECTROLYTIC, 2X1000UF, 50V
C12	110035	CAPACITOR, ELECTROLYTIC, 50UF, 350V

PARTS LIST

ASSEMBLY 400707 POWER SUPPLY ASSEMBLY

REF. DESIG.	PART NO.	DESCRIPTION
CR1	210004	DIODE, SILICON, TYPE SD-4
CR2	210004	DIODE, SILICON, TYPE SD-4
CR3	210004	DIODE, SILICON, TYPE SD-4
CR4	210004	DIODE, SILICON, TYPE SD-4
CR5	210004	DIODE, SILICON, TYPE SD-4
CR6	210004	DIODE, SILICON, TYPE SD-4
CR7	210004	DIODE, SILICON, TYPE SD-4
CR8	210004	DIODE, SILICON, TYPE SD-4
CR9	210004	DIODE, SILICON, TYPE SD-4
CR10	210004	DIODE, SILICON, TYPE SD-4
CR11	210004	DIODE, SILICON, TYPE SD-4
CR12	210004	DIODE, SILICON, TYPE SD-4
CR13	210004	DIODE, SILICON, TYPE SD-4
CR15	220015	DIODE, ZENER, TYPE 1N967B
C01	121088	CAPACITOR, MYLAR, 10NF, 100V
C08	121088	CAPACITOR, MYLAR, 10NF, 100V
C11	120072	CAPACITOR, MYLAR, 10NF, 600V
C13	110041	CAPACITOR, ELECTROLYTIC, 250UF, 6V
C14	101174	CAPACITOR, CERAMIC DISC, 1NF, 500V
C15	110036	CAPACITOR, ELECTROLYTIC, 25UF, 50V
C16	110036	CAPACITOR, ELECTROLYTIC, 25UF, 50V
C17	101174	CAPACITOR, CERAMIC DISC, 1NF, 500V
Q01	200035	TRANSISTOR, TYPE 014
Q02	200011	TRANSISTOR, TYPE 009
R01	030008	RESISTOR, WIREWOUND, 3W, 200 OHM
R02	031450	RESISTOR, CARBON, 2W, 220 KILOHM
R03	000202	RESISTOR, CARBON, 1/4W, 2 KILOHM
R04	030007	RESISTOR, WIREWOUND, 3W, 150 OHM
R05	000151	RESISTOR, CARBON, 1/4W, 150 OHM
R06	000202	RESISTOR, CARBON, 1/4W, 2 KILOHM
R07	000151	RESISTOR, CARBON, 1/4W, 150 OHM
R08	030007	RESISTOR, WIREWOUND, 3W, 150 OHM

PARTS LIST

ASSEMBLY 402000 ASSY POWER SUPPLY

REF. DESIG.	PART NO.	DESCRIPTION
C08	110034	CAPACITOR, ELECTROLYTIC, 2X1000UF, 50V
C09	110034	CAPACITOR, ELECTROLYTIC, 2X1000UF, 50V
C11	110034	CAPACITOR, ELECTROLYTIC, 2X1000UF, 50V
C13	110034	CAPACITOR, ELECTROLYTIC, 2X1000UF, 50V
C15	110034	CAPACITOR, ELECTROLYTIC, 2X1000UF, 50V
C19	110034	CAPACITOR, ELECTROLYTIC, 2X1000UF, 50V
T01	300017	TRANSFORMER, POWER

PARTS LIST

ASSEMBLY 402316 POWER SUPPLY ASSEMBLY

REF. DESIG.	PART NO.	DESCRIPTION
CR1	210004	DIODE, SILICON, TYPE SD-4
CR2	210004	DIODE, SILICON, TYPE SD-4
CR3	210004	DIODE, SILICON, TYPE SD-4
CR4	210004	DIODE, SILICON, TYPE SD-4
CR7	210004	DIODE, SILICON, TYPE SD-4
CR8	210004	DIODE, SILICON, TYPE SD-4
CR9	210004	DIODE, SILICON, TYPE SD-4
CR10	210004	DIODE, SILICON, TYPE SD-4
CR11	210004	DIODE, SILICON, TYPE SD-4
CR12	210004	DIODE, SILICON, TYPE SD-4
CR13	210004	DIODE, SILICON, TYPE SD-4
CR14	210004	DIODE, SILICON, TYPE SD-4
CR15	210004	DIODE, SILICON, TYPE SD-4
CR16	210004	DIODE, SILICON, TYPE SD-4
CR17	210004	DIODE, SILICON, TYPE SD-4
CR18	220015	DIODE, ZENER, TYPE 1N967B
CR19	220015	DIODE, ZENER, TYPE 1N967B
C02	121088	CAPACITOR, MYLAR, 10NF, 100V
C03	121088	CAPACITOR, MYLAR, 10NF, 100V
C04	121088	CAPACITOR, MYLAR, 10NF, 100V
C05	120072	CAPACITOR, MYLAR, 10NF, 600V
C22	110041	CAPACITOR, ELECTROLYTIC, 250UF, 6V
C23	110036	CAPACITOR, ELECTROLYTIC, 25UF, 50V
C24	110036	CAPACITOR, ELECTROLYTIC, 25UF, 50V
C25	101174	CAPACITOR, CERAMIC DISC, 1NF, 500V
C26	101174	CAPACITOR, CERAMIC DISC, 1NF, 500V
Q01	200035	TRANSISTOR, TYPE 014
Q02	200011	TRANSISTOR, TYPE 009
R01	031450	RESISTOR, CARBON, 2W, 220 KILOHM
R02	030008	RESISTOR, WIREWOUND, 3W, 200 OHM
R03	000202	RESISTOR, CARBON, 1/4W, 2 KILOHM
R04	000202	RESISTOR, CARBON, 1/4W, 2 KILOHM
R05	000151	RESISTOR, CARBON, 1/4W, 150 OHM
R06	000151	RESISTOR, CARBON, 1/4W, 150 OHM
R07	030007	RESISTOR, WIREWOUND, 3W, 150 OHM
R08	030007	RESISTOR, WIREWOUND, 3W, 150 OHM

PARTS LIST

ASSEMBLY 402019 CAPACITOR ASSY

REF. DESIG.	PART NO.	DESCRIPTION
C02	110035	CAPACITOR, ELECTROLYTIC, 50UF, 350V
C10	110034	CAPACITOR, ELECTROLYTIC, 2X1000UF, 50V
C12	110034	CAPACITOR, ELECTROLYTIC, 2X1000UF, 50V
C14	110034	CAPACITOR, ELECTROLYTIC, 2X1000UF, 50V
C16	110034	CAPACITOR, ELECTROLYTIC, 2X1000UF, 50V
C17	110034	CAPACITOR, ELECTROLYTIC, 2X1000UF, 50V
C18	110034	CAPACITOR, ELECTROLYTIC, 2X1000UF, 50V
C20	110034	CAPACITOR, ELECTROLYTIC, 2X1000UF, 50V
C21	110034	CAPACITOR, ELECTROLYTIC, 2X1000UF, 50V

Warranty

It is the practice of Dana Laboratories, Incorporated, to manufacture only products of a quality that will merit customer satisfaction. The company recognizes that customer satisfaction is achieved, not only by delivering products meeting advertised performance specifications and having a high level of reliability, but also by honestly and efficiently fulfilling their warranty obligations as set forth below.

Dana Laboratories, Inc., agrees to correct, either by repair or replacement, any defect of material or workmanship in Dana-manufactured units or components which develop within one year after delivery of the equipment to the original purchaser — provided that the equipment has been subjected only to normal and proper use.

In the event of failure of any component delivered with Dana equipment, but not manufactured by Dana Laboratories, assistance will be given the customer in obtaining, from the original manufacturer, reasonable adjustment under that manufacturer's warranty.

Any item claimed to be defective during the warranty period must be returned to Dana Laboratories, Inc., with transportation charges prepaid. The item will be repaired and returned to the purchaser with return transportation prepaid by Dana unless, of course, the item is found not to be defective or found to be damaged by misuse — in which case it will be returned to the purchaser with repair and transportation billed collect.

DANA

Warranty

It is the practice of Plasma Laboratories Incorporated to manufacture only products of a quality that will meet customer satisfaction. The company recognizes that occasionally, not only by the latest customer products advanced performance specifications and having a high level of reliability but also by honestly and flagrantly fulfilling their warranty obligations as set forth below.

Plasma Laboratories Inc. agrees to correct, either by repair or replacement **any** defect of material or workmanship in Plasma-manufactured units or components which develop within one year after delivery of the equipment to the original purchaser — provided that the equipment has been subjected only to normal and proper use.

In the event of **any** component failure during the warranty period, Plasma Laboratories Incorporated will, at its option, repair or replace the defective component **at no charge to the original purchaser,** except for the following:

Any item claimed to be defective during the warranty period must be returned to Plasma Laboratories with transportation charges prepaid. The item will be repaired and returned to the purchaser with transportation charges prepaid by Plasma Laboratories. If service is found not to be necessary, or if damage is found to be caused by misuse — in which case it will be returned to the purchaser with the appropriate charges collect.

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